AN EPITOME OF GENERAL HYGIENE

PREPARED FOR USE IN THE DEPARTMENT OF HYGIENE IN THE COLLEGE OF THE CITY OF NEW YORK

By THOMAS A. STOREY,

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SECOND EDITION

NEW YORK

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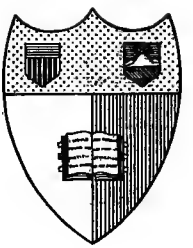
1920



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DEFINITIONS OF THE MAIN DIVISIONS OF HYGIENE

Hygiene. The science and the art of preserving health. "A part of the wisdom of the Egyptians at least 1500 B.C."

General Hygiene. The natural laws that govern health. The science of hygiene includes scientific information concerning the agents that injure health, the contributory causes of poor health, the carriers of disease, the defenses of health and the producers of health (constructive hygiene).

Individual Hygiene. The applications of the natural laws of hygiene for the health welfare of the individual.

Group Hygiene. The applications of the natural laws of hygiene for the health welfare of groups of individuals, the members of a group being associated more or less intimately with each other for considerable periods of time under common environmental influences, common hygienic advantages and disadvantages and under common health responsibilities and regulations. Includes the hygiene of such groups as the family, the school, the occupations and certain public institutions.

Intergroup Hygiene. The application of the natural laws of hygiene for the health welfare of associated groups of humans, the several groups being dominated by common interests, exposed to common health dangers and competent to establish and enforce common standards of individual and group responsibility for community health. Includes the hygiene of the rural community, the village, the city, the town or township, the county, the State, the nation and alliance of nations.

The subject matter of individual hygiene, group hygiene and intergroup hygiene falls very logically into several main divisions. These divisions have been designated in this syllabus as: Educational hygiene, informational hygiene, defensive hygiene, and constructive hygiene.

The important subdivisions of defensive hygiene are protective hygiene, preventive hygiene, remedial hygiene, and aggressive hygiene.

Educational hygiene is the instruction or training in hygiene that leads to the formation of habits of good judgment in matters that relate to health, and to the formation of good habits of conduct in relation to the preservation of health.

Informational hygiene is concerned with the acquisition of accurate

and scientific knowledge relative to hygiene, and it is concerned also with the various methods that are effective for the distribution of this knowledge.

The term "defensive hygiene" needs no explanation other than that connected with the definitions of its subdivisions, which follow. *Protective hygiene* is a subdivision of defensive hygiene and deals with the passive measures that may be adopted for the care of the body and its organs, such as: The building and equipment of habitations or the wearing of clothes, the habit of washing one's hands, and chewing one's food well, and so on. This, of course, is a very large subdivision of hygiene. *Preventive hygiene* includes more active procedures, such as vaccination, or inoculation for the prevention of smallpox or typhoid fever or other disease. *Remedial hygiene* covers first aid and emergency treatment, medical and surgical care, nursing, dentistry, and so on. *Aggressive hygiene* is a term that applies best to group or intergroup procedures that are concerned with the eradication of disease, using the word "disease" in a very broad sense. A "safety-first" campaign is a part of intergroup aggressive hygiene. The campaign against venereal diseases that was developed so vigorously during the Great War was a powerful piece of intergroup aggressive hygiene.

Constructive hygiene covers those parts of hygiene that have to do with growth, development, and the improvement of physiological functions. It includes nutrition, play, recreation, exercise and athletics, work, and rest.

The utility of this framework or outline described above is recommended not only for the larger divisions of practical hygiene, but also such subdivisions of group hygiene as domestic hygiene, school hygiene, or institutional hygiene, and for such subdivisions of intergroup hygiene as rural hygiene, municipal hygiene, State hygiene, or national hygiene.

A WORD TO THE TEACHER AND TO THE STUDENT

A slacker is a human who, being able, fails; one who can but does not try; one who could but does not "deliver the goods."

There never has been a place for such men and for such women; but the dead weight of their burden, the size of their useless expense and the extent of their damage to the community and to the nation is felt more to-day than ever before and we are in no mood for such company.

It is possible to be a teacher-slacker or a student-slacker. There may be civilian-slackers and there may be soldier-slackers. The type of one's occupation does not exclude him from the class.

The program of instruction in hygiene outlined in this syllabus is for the teacher and for the student who proposes to make good. Its usefulness depends upon the determination of each to "deliver the goods."

A successful instruction in hygiene means fewer men in the civilian or military discard, less sickness, fewer postponable deaths, longer lives, greater national human resource, and larger national happiness. But there can be no successful instruction in and no adequate realization of these possibilities if either the teacher or the student is a slacker.

The effective presentation of this subject may be accomplished through recitations, discussions and quizzes, written exercises, inspections, and conferences. Lectures, demonstrations, lantern slides and motion pictures may serve a useful purpose if employed occasionally and without reducing the necessity for thoughtful study on the part of the student and instructor. Informational hygiene is not of much use unless it in some way becomes applied hygiene. The instructor is wholly justified in holding his pupil responsible for the practice of a reasonable degree of good individual hygiene. Poor posture, unclean wearing apparel, dirty fingernails, skin, or hair, poor dental hygiene, uncorrected visual defects, unsatisfactory care of the feet, poor muscular condition, and so on, are, within reasonable limitations, evidences either of poor instruction or of poor application by the student and should be treated and recorded as such. Every recitation should require a thoughtful and careful preparation from the student and from the instructor.

Instruction concerning the facts of General Hygiene and their prac-

tical application in Individual Hygiene and in Group Hygiene and Intergroup Hygiene, as contemplated in this outline and syllabus, involve:

A persistent emphasis of health as a national resource—of man power and of women power as a national asset.

An insistence that individual health is a serious patriotic duty and a compelling social obligation.

An impressive reiteration of the supreme importance of saving the enormous amount of time, productivity, and resource lost in peace time and in war time on account of avoidable accident, preventable disease, and remediable physical defect.

A constant repetition that will drive home the disturbing fact that we lose every day in peace or in war the services of an enormous army of men and women because of physical defect, poor health, avoidable accident, preventable disease, and postponable death.

A convincing statement and restatement of the fact that national health depends equally upon the health habits of the individual on the one hand and upon those of the community on the other, and that the health progress of neither can go very far without the other.

A deliberate and persistent effort to secure a compelling realization by the student of the fact that poor development, incapacity, inadequacy, poor health, and sickness are usually a man's own fault.

The establishment of an ideal that will not permit the individual to expose himself uselessly to disability or disease.

The cultivation of a biting conscience that will sting as against the accusation of being a slacker or a spy whenever a man yields to the temptation of being needlessly sick, as with gonorrhea or syphilis, or becomes voluntarily unfit for peace-time or war-time service, as with drunkenness or sexual excess, or in any other way "aids the enemy" through habits that take his strength, put him out of condition, and make him a burden to those about him.

THOMAS A. STOREY.

THE SCOPE OF HYGIENE

A.—General Hygiene.

I. The Agents That Injure Health.
II. The Carriers of Pathogens.
III. The Contributory Causes of Poor Health.
IV. Defenses of Health.
V. Producers of Health—(Constructive Hygiene).

B.—Individual Hygiene.

I. Informational and Educational Hygiene.
II. Defensive Hygiene—The Care of the Body and Its Organs.
III. Constructive Individual Hygiene.
IV. Individual Hygiene in Relation to Group and Intergroup Hygiene.

C.—Group Hygiene.

I. General Group Hygiene.
II. Special Group Hygiene.
Hygiene of the Home and the Family.
School Hygiene.
Occupational Hygiene.
Institutional Hygiene.

D.—Intergroup Hygiene.

I. General Intergroup Hygiene.
II. Special Intergroup Hygiene.
Rural Hygiene.
Village and City Hygiene.
State Hygiene.
National Hygiene.

GENERAL HYGIENE

PART ONE

THE AGENTS THAT INJURE HEALTH

I

INTRODUCTORY

Whether you know it or not, you young men of the City College are training yourselves poorly or effectively for the life that you are to lead. Every boy and every girl in this country is training a man or a woman every day—physically, mentally, and spiritually—for the demands and for the exigencies of maturity to-morrow. This training is largely unconscious and in the majority of cases one-sided, incomplete and poor. As a result, maturity finds a vast army of our men and women unfit for the demands of life in the home or in the community, and in the service of the country for peace or for war. When we grow up, too many of us find that we are not ready. Our years of youth have been wasted and lost. Are you wasting yours?

Furthermore, whether he knows it or not, the adult human is training himself each day for the days that are to come. The child and the youth have growth and development and functional excellence to achieve. The adult must train to conserve his health or, as he grows older, slowly lose much of what he has. The training of the adult is harder or easier because of the habits of living, good or bad, that dominated his life when young. What are you doing for the man you are to be?

It is obvious that the period for intelligent direction, for wisdom, and for vision in the training for life—in the building of manhood and womanhood—is the combined period of infancy, childhood, and youth. This is your period. Are you making use of it?

The fundamentally important and tremendously large factor in this too often neglected training from infancy to old age, inclusive, is the physical training, or physical education or hygiene of the individual and of individuals in groups. This training is concerned with the acquisition and conservation of health. It is concerned with good health—a quality that is not satisfied with merely "being well."

Good health—good, active, aggressive health—is the most important thing in the world.

If you wish to learn something about the value of health, ask the man who has lost his health—go to the woman who is trying to buy back her health.

Good health—the quality of your physiology that gives you normal organic growth, normal development, and normal function; the state of body and mind that makes it harder for you to be sick and easier for you to get well; the physical condition that brings you a feeling of comfort and well-being, a resiliency and an enthusiasm for the day's work; the thing that removes the fatigue of yesterday and restores your energy for to-day—good health makes possible for you a full measure of success in your life's work, whatever that work may be.

Good health depends largely upon good health habits. Your health to-morrow depends on your habits to-day. "Yesterday is a dream and to-morrow is a vision. But to-day lived right makes of every yesterday a dream of happiness and of every morrow a vision of hope."

Health habits may be classified as: (1) Habits of information—the use of reliable literature and lectures; regular health examinations by competent health advisors. (2) Habits of bodily care—conservation of vision, teeth, etc. (3) Habits of protection—avoidance of the agents that injure health and of the carriers of disease. (4) Habits of constructive hygiene—wise habits of nourishment, adequate excretion, sufficient work, exercise and play, and satisfying rest.

The Department of Hygiene in the College of the City of New York aims to give you practical instruction leading to the formation of health habits along these several lines.

The elective courses offered in physiology and bacteriology are fundamental to an intelligent knowledge of the human body and some of the living agents that injure and destroy its health.

The medical examinations required here every half year enable you, while you are here, to practice habits of health examination and care of physical defects. The College is doing all it can to make these examinations useful. Their real value, however, depends upon the use you make of them.

The Health Talks that we plan to give you once or twice a week will bring to you information on the basis of which you may establish habits of protection against the causes and carriers of disease, and assist you also in the formation of wise habits of daily living.

Our required courses in physical exercise and our free provisions for recreation, play, and for athletic training, are maintained by the college in order to give you opportunities to secure more nearly your full bodily growth, organic development and functional perfection; and to make it possible for you to acquire such habits of constructive hygiene as will conserve and increase your future years of vigorous usefulness.

Remember, then, you are training a man; building a citizen; you are

to-day master of the man you are to be. (1) Good, active, aggressive health is the most important thing in the world, not for its own sake but because the best success of whatever you undertake to do depends upon the good health with which you back up your undertaking. (2) Good health depends upon: (*a*) Habits of information—good, reliable literature, lectures, and demonstrations; and regular, careful, serious health examination; (*b*) sane common sense habits of bodily care, correction and repair; (*c*) vigilant but reasonable habits of health protection, and (*d*) wise habits of constructive hygiene—adequate nourishment, effective excretion, sufficient work, exercise, and recreation, and satisfying rest.

II

CLASSIFICATION OF THE AGENTS THAT INJURE HEALTH

We can not expect in a series of short talks such as we are giving you, to cover all the common agents that injure health. It is, furthermore, impossible for us, under these conditions, to make a thorough study of any single cause of disease. All we plan to do is to make you acquainted with the most important of these enemies of health. These agents may be classified with a fair degree of completeness as follows:

A.—Direct or Primary Causes of Health Injury

(1) Heredity. Limited to the inheritance of some morbid conditions and to increased susceptibility to certain diseases. "There is no true inheritance of infectious disease."

(2) Mechanical agents. Pressure applied in various ways, usually accidentally, causing fractures, concussions, bruises, lacerations, etc.

(3) Physical agents. (*a*) Light; X-ray and other rays; electricity; (*b*) heat and cold; (*c*) atmospheric pressure.

(4) Chemical agents. (*a*) Inorganic poisons such as lead, arsenic, mercury and phosphorus; (*b*) organic poisons such as alcohol, opium, cocaine; food poisons such as physiological poisons in shell-fish and mushrooms; and some of the products of decomposition of animal and vegetable matter.

(5) The vegetable parasites known as "bacteria." They cause such diseases as typhoid fever, relapsing fever, diphtheria, whooping-cough, epidemic cerebro-spinal meningitis, erysipelas, lobar pneumonia, acute rheumatism, Asiatic cholera, plague, bacillary dysentery,

Malta fever, anthrax, glanders, tetanus, gonococcus infection, leprosy and tuberculosis.

(6) Vegetable parasites other than bacteria. Actinomycosis, oidomocosis, mycosis, etc.

(7) Protozoa or unicellular animal organisms. (*a*) Malaria; (*b*) tympanosomiasis or sleeping sickness, caused by a trypanosome; (*c*) amebic dysentery; (*d*) syphilis, caused by the treponema pallidum.

(8) Multicellular animal parasites or metazoa (worms and insects principally). (*a*) Fluke worms; (*b*) tapeworms; (*c*) round worms such as hookworm, pinworm, trichenella spiralis, various filaria; (*d*) leeches; (*e*) tongue worms; (*f*) acarines.

B.—The Indirect or Contributory Causes of Poor Health

The contributory causes of poor health are those influences that make it easier for human beings to become sick or harder for them to get well. They include:

(1) Those influences that favor the production, distribution or vitality of the specific causes or carriers of disease.

(2) Those influences that tend to interfere with or break down our environmental defenses against poor health and disease.

(3) Those influences that tend to weaken or destroy our bodily (anatomical and physiological) defenses against disease.

The following may be cited as examples of contributory causes of poor health: (The subject will be covered another term.)

(1) These influences may exist in the environment, *e.g.,* excessive fog; excess of moisture in the air or soil; high and low temperatures; excess of or lack of sunshine; warm, dry and stagnant air; air contaminations; noise.

(2) These influences may be physiological, *e.g.,* age; sex.

(3) They may reside in abnormal bodily conditions, *e.g.,* heredity; defective vision; obstructed breathing; decayed, unclean teeth and sore gums; flat feet; curved spine, flat chest; obesity, emaciation; chronic disease; after-affects of acute disease; affects of trauma (gross injuries, injuries from dust, irritating vapors, gases, chemicals).

(4) They may be connected with insufficient bodily nourishment, *e.g.,* insufficient food; poor food; bad habits of eating; insufficient air; insufficient water.

(5) Interference with excretion may be a contributory cause of disease, *e.g.,* by way of the respiratory tract, the genito-urinary tract, the skin or the bowels.

(6) Interference with special functional activities may contribute to

the production of disease, *e.g.*, through the lack of physical exercise, or through nervous excitement, worry, apprehension, fear or depression, or through lack of sleep.

Remember: That the indirect or contributory causes of poor health are those influences which tend to make it easier for you to be sick and harder for you to get well. The exciting causes of poor health act more certainly and more injuriously when the contributory causes have prepared the way.

III

THE HYGIENE OF HEREDITY

The vehicle of inheritance. (*a*) All living things—plants or animals—are produced by the union of two germ cells (parent cells), or they are produced by the division of a single parent cell. (*b*) The nucleus of the parent cell is the vehicle of inheritance. The problems of inheritance are problems of the nucleus of the germ cell.

The inheritance of disease and the inheritance of tendencies to become diseased are limited to those morbid conditions in the parent which may affect the quality of the nucleus of the parental germ cell.

Examples of racial hereditary disease. (*a*) White races are more susceptible to yellow fever than other races. (*b*) The negroes, to sleeping sickness. (*c*) The negroes and American Indians to tuberculosis. (*d*) Gout is more common to the English, obesity to the Dutch, and obesity and diabetes to the Jews.

Examples of family hereditary disease. (*a*) Reappearance of identical diseases—gout. (*b*) Appearance of related diseases—obesity, rheumatism, gout. (*c*) Inheritance through father—gout. (*d*) Inheritance through mother—hemophilia. (*e*) Family tendencies to infectious disease—a lack of resistance to tuberculosis, acute rheumatism, measles, scarlet fever, etc. (*f*) Constitutional or nutritional diseases, tendencies to gout, rheumatism and diabetes. (*g*) Nervous diseases and tendencies to nervous diseases. The most common type of hereditary manifestation of disease. Hysteria, migraine, epilepsy, various convulsive affections, various paralyses, certain atrophies, and various forms of mental abnormality, including idiocy, imbecility and insanity.

The possibility of there being such a thing as the inheritance of acquired injury. (*a*) No such thing as inheritance of gross mutilations; nor transmission of maternal impressions; nor inheritance of training or lack of training; nor inheritance of infectious disease. (*b*) Poisons cir-

culating in the blood may injure the germ cells directly or indirectly through injury of other organs so that these injuries may result in the production of damaged offspring. Alcohol may lead to sterility, early death of infant, or to mental, moral or physical weakness of offspring. Lead poisoning and poisoning with nitrate of mercury have same influence as alcohol. Bacterial poisons may be in same class. (*c*) Severe constitutional disease is known to have a profound influence on the germ cells, producing sterility, death of infant, production of weaklings, and imperfections in later generations.

Syphilis is an example of a constitutional affection having seriously important influence on heredity. The infection itself is not inherited. The infection may be transmitted congenitally. The constitutional affects of the disease may offer severe injury to the germ cell, causing sterility, death of the unborn or newly born child, or weakness, incapacity and uselessness in the living offspring.

Your health problems of heredity are: (*a*) The health problems resulting from your heredity, and (*b*) the health problems which you transmit. You have some control over (*a*) and you have a large control over (*b*).

Community, hygiene and heredity. (*a*) Alcoholism, venereal disease, industrial disease, etc., in their possible relation to the emphasis, initiation and transmission of hereditary diseases are serious community problems. (*b*) The relation of pauperism, mental degeneracy and crime to heredity justifies community interference with the initiation and perpetuation of such heredity. (*c*) The fact that war destroys the fit and leaves the unfit and the less fit to dominate posterity is a matter deserving the most serious concern of all society. (*d*) Field of eugenics.

IV

PROBLEMS OF HEALTH AND DISEASE THAT ARISE DURING THE PRENATAL PERIOD

Every human being is the product of the union of two germ cells, a maternal germ cell and a paternal germ cell.

The union of these two parental germ cells forms a single cell which is called the fertilized ovum.

This single cell contains all the heredity and all the possibilities which the parental stock is able to contribute.

Rapidly this single cell divides into two cells; these two into four; the four into eight; the eight into sixteen; and so through a process

of multiplication by two the single cell becomes hundreds, thousands, and thousands of millions of living tissue cells. For a prenatal period of about 287 days these living cells are multiplying, organizing, adjusting and developing into a human form, a human structure, a human being.

During this prenatal period, the growing human embryo may be injured or diseased through serious injury, disease or poor health of the mother. This injury may be accomplished by overwork of the mother, rough treatment or insufficient nourishment of the mother, leading to weak, puny or non-resistant offspring, or even to the birth of a dead infant. Heart disease, kidney disease, syphilis, and other diseases of similar importance may bring about these results.

Alcoholic women, and women who work in lead and with nitrate of mercury may be unable to bear live children; or lose them soon after birth; and may bear idiots, imbeciles and epileptics.

Poisons like alcohol, lead, mercury, arsenic, carbon monoxide and morphine easily pass from the circulation of the mother to that of the unborn child.

Infectious diseases do not often pass from the mother to the fetus, but such transmissions do occur. There are recorded cases of fetal infection with syphilis, tuberculosis, smallpox, chickenpox, measles, scarlet fever, erysipelas, septic disorders, acute rheumatism, typhoid fever, cholera, cerebro-spinal meningitis, influenza, mumps, relapsing fever, malaria and yellow fever. The list is a long one but the number of cases on record is small. (Adami.)

The influences that may lead to injury of the unborn infant as described above may be classified as: (*a*) Physical or mechanical; (*b*) nutritional; (*c*) toxic; (*d*) infectious.

Problems of Health that Arise at Child-birth

Child-birth not infrequently exposes the infant to physical or mechanical injury, or to contact infection. It occasionally happens that the life of the infant must be sacrificed in order to save that of the mother. This situation is rare and is usually the result of natural interferences with the normal delivery of the child. More commonly it is necessary for the physician to assist the birth by manual or instrumental measures. These procedures save many lives, both of mothers and infants, but they are occasionally accompanied by physical injuries of more or less serious importance to the mother and to the child.

The most common and the most serious infection of infants at this

time is gonorrhea. Less common infections are from various pus organisms. Gonorrhea in the new born is usually located in the eyes. Fortunately, this serious infection is becoming less common, but it is probably even yet fair to state that more infants are made blind in this than in any other way. Thus the infant suffers because of the careless hygiene of its parents. A disease of shame and sin so far as the parents are concerned, and a disease of careless uncleanliness so far as the child is concerned.

SUMMARY

The prenatal period and the period of birth are, then, periods in which the hygiene of human life requires special forethought and care. The overworked mother, the underfed mother, the sick mother, must necessarily fail to protect and to nourish her unborn babe adequately. Responsibility for such failure must rest upon the father quite as much as the mother. This responsibility is often a responsibility of society itself. The community regulation of women's work is of great importance in those occupations which stamp their damage upon the power of motherhood and on the vitality of offspring.

It must be obvious, too, that the unborn babe and the babe at birth are often made to suffer in punishment for the unhygienic habits of either or both parents. The various infections, particularly those of syphilis and gonorrhea, figure especially in events of this sort.

V

THE MECHANICAL AGENTS THAT INJURE HEALTH

The mechanical causes of injury, poor health and disease, are the common factors that give serious importance to most of the accidents that happen to human beings.

These mechanical causes of injury are classified by Adami as follows: (*a*) Concussion. (*b*) Puncture, with which may be included the influence of projectiles under high velocity. (*c*) Section. (*d*) Contusion, with which may be included lacerations and tearing. (*e*) Compression. (*f*) Distension. (*g*) Atmospheric pressure.

These influences operate most commonly in the accidents that occur in our various industrial enterprises, such as railroads, mines, metallurgical plants, factories and construction works. The lowest estimate (1916) places the fatal accidents to adult workers in the United States at 35,000 a year, with an additional 1,250,000 non-fatal accidents.

(*Journal of the American Medical Association.*) The Massachusetts Industrial Accident Board (1915) estimates 75,000 fatal accidents yearly to workers of all ages and more than 3,000,000 non-fatal accidents.

Drowning may be classed as mechanical injury to human life. There were in 1915, in the area of registration, 6,514 deaths from accidental drowning. This is a very strong argument in favor of a swimming requirement for all children.

Murder and suicide are commonly effected by mechanical means though not infrequently chemical. Reports from the registration area containing 67.1 per cent. of the total population of the United States indicate that in 1915 there were in this area 11,216 suicides and 4,670 homicides.

During its first five months, the Great War was responsible for the loss of more than two million human lives. The gross direct injuries of war are largely mechanical. Estimates made in 1919 place the number above 9,000,000. (War has a powerful contributory influence on communicable disease, an emphasis on hereditary degeneracies, and a destructive effect on community morals, not to be confused with the direct mechanical effect of powder and ball.)

Mechanical injury figures largely in the affairs of every community through all divisions of the population. The laborer is most often affected, but accidents involving mechanical injury of varying degree of seriousness are common to all classes.

Mechanical injuries are in a very large degree preventable. Safety appliances are being adopted commonly in our industrial plants. "Better safe than sorry," is the motto of many a "Safety First" campaign in our larger communities. It is a good motto for individual guidance. If half these injurious and fatal accidents could be avoided each year, the saving in human life, human suffering and human misery would be enormous.

What have you done to protect yourself from mechanical injury? Have you the muscle and the nerve to control a runaway horse? Could you save your life by climbing down a rope fire-escape? Can you jump quickly enough and far enough to avoid an automobile? Can you run fast enough to get out of the way? Could you run long enough? Could you escape from a sinking boat? A hundred feet from shore? A half mile? Can you swim? What are you prepared to do to defend yourself and your country from the mechanical injuries of war?

VI

THE PHYSICAL AGENTS THAT INJURE HEALTH

The physical agents that injure health may be classified as follows: (*a*) Atmospheric pressure, diminished pressure, excessive pressure; (*b*) temperature, low temperature, high temperature; (*c*) light, insufficient light, excessive light; (*d*) the *X*-ray; (*e*) radium; (*f*) electricity, lightning, commercial electricity.

Variations in *atmospheric pressure* are not of much importance in the affairs of the ordinary individual. Those who climb high mountains or make balloon ascensions to great heights may suffer with giddiness, rapid breathing, rapid heart rate, nose-bleed, weakness and exhaustion. These are effects of low atmospheric pressure. They are symptoms due to an insufficient supply of oxygen in the blood. Men that work in caissons, building tunnels under rivers, for instance, suffer from the effects of high air pressure. The laborer who returns from such work to normal air pressure too rapidly suffers excruciating pain, and, in some cases, death. The excessive air pressure forces the blood to take on an increased amount of oxygen, nitrogen and carbon dioxide gas. When the excessive pressure is reduced suddenly, it seems that the blood is unable to get rid of its increased amount of nitrogen as rapidly as it does the other gases it has taken up. The bubbles of nitrogen remaining in the blood cause the pain and fatality.

Variations in temperature are of importance in temperate and arctic zones.

Low temperature causes chilblains, frost bites and freezing, none of which are common or of much importance in this part of the world. In colder climates they are of more serious concern. Six persons froze to death in New York City in the winter of 1916. Three hundred and fifty-four persons died of excessive cold in the area of registration in 1918.

Cold may lower the temperature of the body and thus reduce its resistance to disease.

High temperature may cause: (1) Heat stroke—a result of hot, moist weather—may be headache, rapid pulse, rapid respiration, loss of consciousness, death. In 1915, area of registration, there was 407 deaths from effects of heat. (2) Burns; may vary in degree from simple redness to cremation. Death follows if half the body is burned enough to cause blisters. Death follows if from one-sixth to one-eighth of the skin surface is destroyed by burning. Burned areas are easily infected. The septic wounds that occur in such areas are often

very serious. The scars that follow burns may cause incapacitating deformities. In the area of registration (1915) there were 4,804 persons accidentally burned to death; in addition, 971 lost their lives in conflagrations. In New York City in 1916, 428 persons were fatally burned.

Light as a source of injury to health. Insufficient light; not a specific cause of disease; may contribute to produce, or help produce poor health. A factor in causing eye strain.

Excess of light, particularly sunlight. The red rays of the sun produce heat. They are factors in heat stroke referred to above. The violet rays and the ultra-violet rays of the sun are of special importance. They may cause sunstroke when the rays of the sun fall directly on the head and neck. The symptoms of sunstroke are pains in the head and neck, nervous excitement, convulsions and loss of consciousness. Death may come in an hour. In the summer of 1916, fifty-eight persons in New York City died of sunstroke. Milder cases recover, but they frequently develop a permanent nervous disorder of some sort. These rays (violet and ultra-violet) cause sunburn. Severe sunburn is very painful. The burned area may easily become infected.

The *X-ray* and *radium rays* are sometimes causes of disease among the specialists who use them or work with them. These rays may cause sterility in the men and women. They sometimes cause "burns" that develop into cancerous growths.

Electricity as a physical cause of injury. Lightning may cause death or prolonged unconsciousness. Burns from lightning heal very slowly. Commercial electricity used for service and for industrial purposes is frequently the cause of injury. The seriousness of this injury depends on the amount of current that passes through the victim; the area of contact, and the region affected. Currents of low voltage and moderate frequency may be fatal if the heart is in the circuit. The electric current may cause nervous disturbances, burns, loss of vision and death. Five hundred and fifteen deaths were reported from electricity (lightning excluded) in 1915 in the area of registration. Two hundred and twenty-one were reported due to lightning. It not infrequently happens that the heart continues to beat after breathing has been stopped by the electric current. In such cases the use of artificial respiration may save the victim from dying. (The best method of artificial respiration is the Schafer or the prone pressure method.) One should never handle loose electric wires, switches, unless he is certain of their safety and of his own protection. Carelessness has often lead to fatality.

VII

THE CHEMICAL AGENTS THAT INJURE HEALTH

Acute poisoning not included in this discussion. It may be noted, however, that there were 1,286 deaths reported in the area of registration from acute poisoning in 1915. Chemical agents may exist in solid, liquor, or gaseous forms. They may be either inorganic chemicals or organic chemicals.

The Inorganic Chemicals that Injure Health

Lead.—The cause of chronic lead poisoning.

Source.—Poisoning from lead is common in those industries in which lead is handled, *e.g.,* lead mining and smelting, zinc smelting, working in lead and lead colors, making lead pipes and various other lead objects, making pottery and earthenware, type making, working in electric storage battery factories, and installing gas and water pipes.

Susceptibility.—Increased by bad habits, lack of condition, chronic illness.

Mode of Entrance.—Skin absorption plays a part. Inhalation of vapor of lead is a "questionable occurrence." Ingestion into the stomach is the important route.

Symptoms.—Varied and inconstant. May be colic, paralysis, convulsions, delirium and death. One hundred and fifty-five deaths from chronic poisoning are reported for the area of registration in 1915. Most cases recover. (For effects on offspring see chapter on "Inheritance" and the "Prenatal Period.")

Avoidance.—Poisoning by lead is avoidable through habits of cleanliness. Lead workers should wear gloves when practicable; always wash their hands before eating; never put their fingers in their mouths; omit smoking while hands are smeared with lead compositions; exercise care that their food is not contaminated with lead.

Arsenic.—The cause of chronic arsenical poisoning. Importance has greatly decreased in recent years. Source of poisoning from arsenic is now limited to arsenical beer (England); a few industrial occupations; criminal usage; and the therapeutic use of the drug (Edsall). Massachusetts law in 1900 limited the amount of arsenic to be used in coloring paper and articles of dress. Country is now almost free of poisoning from this source.

Mode of Entrance.—Inhalation; external application; ingestion.

Mercury.—The cause of chronic mercurial poisoning. Importance has greatly decreased since greater care is being used in administering

mercury medically, and since mercury is now less commonly used industrially. Chief sources of mercury poisoning now are mercury mining and smelting, manufacturing of thermometers and barometers, and the manufacture of felt hats.

Mode of Entrance.—Inhalation of vapor, the chief avenue of entry. Absorption through the skin also important. Ingestion not common.

Symptoms.—Chiefly mental, nervous and digestive. Recovery probable in mild cases. (For effect on offspring see chapters on "Inheritance" and the "Prenatal Period.")

Phosphorus.—The cause of chronic phosphorus poisoning. The importance of phosphorus poisoning has greatly decreased in recent years because of stringent laws and improved methods of manufacture. Chief source is the white phosphorus used in making matches.

Mode of Entrance.—Ingestion. *Symptoms* may be severe. Necrosis of the bones of the jaws is the most common local symptom. This necrosis reaches the surrounding tissues and may become extensive. Foul odor, repulsive appearance, deformity, and death are not uncommon effects of the disease.

Prevention.—Stop using white phosphorus. Keep the mouths of working people clean.

Carbon Monoxide.—Importance is increasing because of the opportunities for acute and chronic poisoning from various industrial sources.

Sources.—Pure carbon monoxide (from electric furnaces) illuminating gas; products of combustion.

Mode of Entrance.—Inhalation. *Symptoms* arise from injuries to the blood, kidneys and brain. Three hundred and forty-five persons lost their lives from illuminating gas in New York City in 1916.

The Great War has produced some new poisonous chemicals of terrible power. The gases used in offensive warfare include chlorine, phosgene, xylil bromid or benzyl bromid, phenzl carbylamin chlorid, diphenyl-chloroarsin, dichloro-diethzlsulphid. Used as gas clouds, in gas bombs, and in gas shells. Protective devices have been produced for all these gases.

The manufacture of high explosives is accompanied by danger to the workmen because of the poisonous properties of some of the chemicals used. Among the most dangerous in this class are picric acid, trinitrotoluol, and the fulminate of mercury.

VIII

SOME OF THE ORGANIC CHEMICALS THAT INJURE HEALTH

The most important organic chemical poisons that may be placed in this group are alcohol, opium, morphine, cocaine, various food poisons, snake and other venoms and the organic chemical poisons that cause the auto-intoxications. (This discussion is based largely on the facts presented in Osler's Modern Medicine, Vol. 1, Part IV.)

Alcohol.—Varieties of alcohol. Methyl alcohol, known as wood alcohol, is used to adulterate cheap whiskies. Very dangerous. Ethyl alcohol, main factor in alcoholic drinks. The higher alcohols (Fusel oil). Relation to acute or chronic alcoholism probably unimportant.

Sources of Alcohol (Ethyl).—Certain patent medicines contain from 6 per cent. to 47½ per cent. alcohol. The public uses large amounts of patent medicines. Many persons acquire the habit of using alcoholic drinks in this manner. Physicians' prescriptions not infrequently contain alcohol. The bar-room, the restaurant and the drug-store are the common sources from which alcohol may be secured in one form or another.

Effects of Alcohol.—Between 1895 and 1905 there were admitted to the alcoholic wards of the Bellevue Hospital 43,916 men and 16,076 women. The statistics from many institutions show that from 20 to 75 per cent. of these alcoholics have had either an alcoholic father or mother or both parents given to such excesses. (Lambert.)

Acute Poisoning with ethyl alcohol (ordinary intoxication) may cause death. In 1915 there were 2,945 deaths reported in the area of registration from acute and chronic alcoholism.

Chronic Poisoning.—The habitual use of alcohol is known to produce the following effects upon men and women: It causes the muscles of the heart to become degenerated and weak. This is not infrequently the cause of premature death. The blood vessels (arteries) often become hardened and therefore liable to break. Hardened arteries are factors in causing the symptoms of old age. A broken artery means a hemorrage. If the artery is large, death follows. If the artery is in the brain, death or paralysis follows. The liver may become diseased. This is not uncommonly the basis for a general disability, finally ending in death. The stomach is usually badly treated by the alcoholic. He suffers from indigestion which is sometimes most severe. Chronic alcoholism sooner or later injures the kidneys. Since the kidneys are the most important excretory organs in the body, such injury is serious.

Chronic alcoholism often causes sterility in women and impotence in men. The brain may be affected, leading to delirium tremens and hallucinations, and to homicidal and suicidal tendencies. The nerves may be paralyzed. The general resistance of the individual is reduced so that he gets sick more easily and recovers with more difficulty. The mortality of alcoholics with pneumonia is twice that of non-alcoholics. The chemical and physical agents that cause disease are more injurious to the alcoholic than to the non-alcoholic. The children of alcoholic mothers have 2.5 times the mortality of those of non-alcoholic mothers. They are often still-born, and if they do live are weak and non-resistant. The children of alcoholic parents are often epileptic, idiotic or weak-minded. The alcoholic is of weak will and blunted moral sense. He is unclean, untidy, and often filthy. He loses his sense of shame, his feeling of domestic or community obligation, and his love for those that should be near and dear. The drunken father and the drunken mother are destroying themselves physically, mentally and morally while they are transmitting their mental and moral weaknesses to their children through heredity and through example.

The Mortality Bill Against Alcohol (Life Extension Institute's Monthly Letter, Number 12): "In a number of life insurance companies, chiefly in Great Britain, the abstainers were separated from the rest of the policyholders (all accepted as temperate and healthy risks), and the difference in the death-rate determined. In the United Kingdom Temperance and General Provident Institution of London over a period of forty-five years the mortality of the non-abstainers, or so-called moderate drinkers, accepted as temperate and healthy risks was 37 per cent. higher than that among the total abstainers. In the Sceptre Life Association of London over a period of twenty-seven years the mortality of the non-abstainers was 54 per cent. higher than among the total abstainers. In the Scottish Temperance Life Assurance Co. of Glasgow, over a period of twenty-nine years, the mortality of the non-abstainers was 44 per cent. higher than among abstainers. In the Manufacturers' Life Insurance Co. of Canada over a period of eight years the mortality of the non-abstainers accepted as temperate and healthy risks was 78 per cent. higher than among the abstainers. There has recently been compiled the experience of forty-three American life insurance companies extending over a period of twenty-five years. The death-rate among certain types of drinkers was compared with that among insurance risks generally. The results follow, supporting the evidence derived from British companies: First, those who were accepted as standard risks but who gave a history of occasional alcoholic excess in the past. The mortality in this group was 50 per cent. in

excess of the standard mortality, equivalent to a reduction of over four years in the average lifetime of the group. Second, individuals who took two glasses of beer, or a glass of whiskey, or their alcoholic equivalent, each day. In this group the mortality was 18 per cent. in excess of the standard. Third, men who indulge more freely than the proceeding group, but who were considered temperate and acceptable as standard insurance risks. In this group the mortality was 86 per cent. in excess of the standard. In short, we find among alcohol users the following increases of mortality over the standard or average death-rate among insured risks generally:

Death-rate in Excess of Standard

Steady moderate drinkers, but accepted as standard risks.....	86 per cent.
Having past excesses.....	50 " "
Very moderate drinkers.....	18 " "

"This means that steady drinkers who exceed two glasses of beer or one glass of whiskey daily should be charged a heavy extra premium, and that there is a distinct extra hazard even on those who drink to a lesser degree. In these groups, the death-rates from Bright's disease, pneumonia and suicide were higher than the normal. Unfortunately, in the investigation of American companies, no comparison was made with total abstainers. It is evident, however, from the trend of the figures and the results shown by British companies, that such a comparison would show the abstainers to have a long lead in vitality over the very moderate drinkers."

Prevention.—Many books are written on alcoholism and its prevention. This is a matter of personal and community concern. You must avoid such habits yourself and you must use your influence as a voting citizen to protect your family and your community from this influence.

IX

ORGANIC CHEMICAL AGENTS THAT INJURE HEALTH
—Continued

Opium and Its Derivatives.—In this group are opium, morphine, codein, heroin and other lesser important drugs.

These organic chemicals, called alkaloids, are secured through direct purchase, physicians' prescriptions, or in patent medicine. Opium may be smoked. It and the other derived drugs are more commonly taken by mouth or hypodermically. Laws are formulated in many States to

restrict the sale of such drugs. We have also a Federal law to this same effect. Medical teaching nowadays is directed against such use of these drugs as may lead to habit formation. These drugs cause acute poisoning if taken in any but small doses. Death may easily follow. They are taken by unfortunate human beings who have formed a habit of using them. At first, small doses produce a cessation of pain, and sleep. The habit is easily formed. After a while it takes more and more of the drug to produce the desired effects. Very undesirable effects soon appear. With the smoker of opium the will is weakened. There is loss of memory, despondency, suicidal tendency, general tremor, a deathly pallor, failing eyesight, rapid pulse, chronic bronchitis, indigestion, constipation, itching skin and often vomiting. With those who take opium by mouth there is finally a degeneration of mind, morals and physique. There is a loss of self-respect, with insomnia, emaciation and a tendency to melancholia, dementia and sudden death. With those who take morphine by mouth or the hypodermic, there are three stages of the disease: Exaltation, intoxication, and emaciation. The habitue ends by loss of character, will and morals. He is beset with nightmares. His hair falls out; his teeth decay; his face is drawn and aged. Emaciation becomes extreme. A continual delirium may ensue and death ends the habit. The habitual use of morphine and its derivatives is very difficult to break. It is better never to know what drugs you are taking when you are sick. Leave that to your doctor. If you are in pain, don't hunt for relief through drugs. Stick it out as long as you can. *Get a good doctor and trust him.*

Cocaine.—This drug is present in certain prescriptions and patent medicines. It is used habitually by the same type of persons that use opium and morphine. It is taken hypodermically or by the mouth. Very small doses sometimes cause death, the sense of sight, hearing and smell become seriously impaired. The patient hears persecuting voices, and sees strange, threatening objects. A delusional insanity develops. Suicidal or homicidal impulses may appear. This drug is more quickly and intensely destructive than alcohol or opium.—(Lambert.)

Remember: Alcohol, opium, morphine and cocaine are common habit-forming drugs. You should take no chance leading to the formation of such habits. Look out for drinks and patent medicines containing these poisons.

X

CHEMICAL AGENTS—*Continued*

Tobacco.—The injuries that may result from the use of tobacco are probably of chemical origin. We possess no accurate information as to the exact nature of the chemical actions involved. The use of tobacco is often attended with such phenomena as nausea (ordinarily only in beginners); indigestion; slightly increased heart rate; moderately increased blood pressure; wakefulness; nervous irritability; lessened accuracy of muscular coordinations; increased susceptibility to fatigue; dry and irritable lining (mucous membrane) of the nose, throat, tongue and mouth; loss of vision (occasional and temporary), and acid dyspepsia.

Evidence has been produced which would seem to show that only half as many smokers as non-smokers are successful in the "tryouts" for football squads; in the case of able-bodied men, smoking is accompanied by a loss in lung capacity amounting practically to 10 per cent.; smoking is invariably associated with low scholarship (Pack, *Popular Science Monthly,* October, 1912).

The tobacco habit is not a clean habit. It is frequently offensive to non-users and is the basis for much bitterness on the part of such non-users. It is evidently unwise for children, young adults, and delicate, sickly, nervous, or irritable persons to use tobacco. The habitual smoker should seek regular, careful medical examination for the early detection of such injuries as have been noted above.

XI

THE BACTERIA THAT INJURE HEALTH

Bacteria are very small plants. They are invisible to the naked eye. Some are so small as to be invisible to any but the most powerful microscopes. We have reason to believe that there may be some bacteria too small to be seen with any means now known to science.

The Non-pathogenic Bacteria.—There are two broad classes of bacteria, *e.g.,* those that cause disease—the pathogenic bacteria—and those that do not cause disease—the non-pathogenic bacteria. Unfortunately, it seems to be true that under certain conditions non-pathogenic bacteria may become virulent, and therefore pathogenic. It is equally true, fortunately, that pathogenic bacteria sometimes lose their virulence, and thus become, temporarily at least, non-pathogenic. The

non-pathogenic bacteria exist in enormous numbers everywhere. They are far more numerous than the pathogenic bacteria. The cleanest milk you drink contains millions of them. The best city water contains them. Our surroundings, food, air and water are infected by them. But these organisms are ordinarily absolutely harmless. Many of the non-pathogenic bacteria are not only harmless in their relation to disease, but are important in their beneficial relation to health and life. In fact, all human, animal and plant life would disappear in the course of time if the valuable services of some of these bacteria should be lost.

The Importance of the Non-pathogenic Bacteria to Human, Animal and Plant Life

The "Carbon Cycle."—Carbon is essential to the life of all plants. No plant can live without it. Commonly plants secure their carbon from the carbon dioxide in the air. They "breathe" through their green leaves much as we breathe through the wall of our lungs. The plant retains the carbon and returns the oxygen to the air. The carbon is then used by the plant in building its structure. It is the chief chemical in wood. It is present in all fruits, vegetables, cereals and other vegetable foods. Animals eat the plants and thus secure the carbon which the plants have used in producing their fruits, seeds, leaves and stalks. Animals use this carbon in building their tissues, or in producing their secretions. Every tissue cell in the animal body contains carbon. Human beings eat plants, plant foods and animals. Thus the human animal secures the carbon it needs for its cells from plant life. Every cell in every tissue and every organ of your body and mine contains carbon. Carbon is absolutely essential to all life, animal or vegetable.

Whenever a plant, or an animal, or a human being discharges excretions from any of its organs, those excretions contain carbon. Some of the non-pathogenic bacteria "feed upon" those excretions and break them up into simple chemical compounds. Carbon dioxide is one of the important products of the action of bacteria upon organic excretions. Whenever a plant, or an animal, or a human dies, the non-pathogenic bacteria "feed" upon the dead body and decompose it. These thus break up the complex chemical compounds into simple chemical compounds. Carbon dioxide is always produced in such bacterial action.

The carbon dioxide released by bacteria in their decomposing influence on the dead bodies of the plant, animals and humans, and on the organic excretions, secretions, and discharges from those same

sources, passes into the air, and is again available as plant food. It may be again breathed through the green leaves of living plants and thus continue the "carbon cycle."

It is obvious that this substraction of carbon from the air, and this addition of carbon to the air must balance. If, through the course of centuries, less carbon were returned than taken out, the air would finally have too little carbon to meet the needs of plant life, and plants and animals and humans could live no longer.

The "Nitrogen Cycle."—The nitrogen cycle is very like the carbon cycle except that nearly all plants secure their nitrogen compounds from the soil through their roots. When the non-pathogenic bacteria decomposes dead human animal and plant bodies into simpler chemical compounds, they return nitrogen to the soil in simpler forms that are again available for plant life. Some bacteria take nitrogen from the air and store it in the structure of the plant in forms available for animal food.

Nitrogen is requisite for all human and animal life. Every tissue cell in our bodies must have nitrogen. If the non-pathogenic bacteria should "go out of business" there would be this second reason why all human and all animal life would disappear.

There are Other "Cycles" of lesser importance such as the "phosphorus cycle" and the "sulphur cycle." These cycles all demonstrate the fact that human life as we now know it would be impossible without the service of the non-pathogenic bacteria.

Commercial Values of the Non-pathogenic Bacteria.—Some of these bacteria give flavor to butter. Others ripen cheese. Some are important in the manufacture of vinegar, acetic acid, the tanning of hides and the curing of tobacco.

XII

PATHOGENIC BACTERIA—*Continued*

The Pathogenic Bacteria.—The pathogenic bacteria are the bacteria that cause disease. Our common colds, sore throat, attacks of bronchitis, are caused usually by pathogenic bacteria. Among the more common pathogenic bacteria are: The bacilli of typhoid fever, the pus cocci, the gonococci, the diplococci of meningitis, the bacilli of diphtheria, the bacilli of whooping-cough and the bacilli of tuberculosis. All bacteria, pathogenic and non-pathogenic, commonly appear in one of three forms. The *cocci* are round, dot-like forms, such as the pus cocci that cause boils and abscesses. A coccus may be as small as one two-hun-

dred-thousandths of an inch in diameter. The *bacilli* are longer rod-like forms such as the bacilli of typhoid fever and tuberculosis. The tubercle bacilli average about one fifty-thousandth of an inch in diameter. The *spirilla* are curved forms such as the spirillum of cholera. The spirilla are the largest of the bacteria.

Some bacteria are motile because of hair-like fringes (flagellae) which have a characteristic motion.

Some bacteria produce spores; others do not. A spore is a more resistant seed-like structure which the bacterium manufactures within its body. The spore is usually roundish and much smaller than the bacterium from which it came. More will be said about spores later. Bacteria live in dark, damp, warm and dirty places. They die in sunshine; drying kills most of them. They do not grow well in the cold. High temperatures destroy them.

Pathogenic bacteria grow best in the tissues or in the tissue juices of human beings and animals. Some pathogens will grow only in the human beings. Many pathogenic bacteria will not grow in nature. Pathogenic bacteria may remain alive for hours, days, weeks, or even months in favorable surroundings. Some bacteria die more quickly than others under such circumstances. We find tubercle bacilli in human spit. If such sputum is left in dark, damp and warm places, the bacilli in the sputum will live for a long while. Typhoid bacilli will live for a long while in cows' milk. If the milk is warm they will grow there. Pathogenic bacteria are found in the normal human throat; between the teeth; in the nose; under the eyelids; under the nails; in the creases and pores of the skin; in the intestines; in the respiratory, intestinal and genito-urinary secretions, excretions and discharges.

The Multiplication or Reproduction of Bacteria (applies to all bacteria).—Bacteria reproduce rapidly. Each bacterium grows by separating into two parts. A bacillus divides transversely so that two bacilli are formed, each about one-half as long as the original bacillus was. A coccus divides into two cocci; a spirillum into two spirilla. We call this multiplication by binary fission.

It takes a bacterium on the average about one-half hour to divide into two bacteria. Some divide in fifteen minutes; others take an hour.

If a single bacterium could be unhindered in its multiplication by binary fission, if all its descendents could multiply without restriction, it would be possible within a day and a half to increase that one single bacterium to 9,544 billions of bacteria, which would weigh fifteen thousand tons. Fortunately, conditions are never favorable for such unrestricted growth.

Some bacteria produce spores. A spore is a "seed" or "egg" which is capable of resisting influences which would destroy the bacterium which produced it. Spores are much smaller than the bacteria from which they come. A spore is much harder to destroy than the adult bacterium. It may lie a long time in a dormant condition. The spores of anthrax are said to have been found alive after thirty years of quiescence. When its surroundings are favorable, when the temperature, the humidity, and food supply are favorable, the spore begins to grow and soon becomes an active bacterium which multiplies in the usual way by binary fission. There are, then, two sorts of bacterial reproduction—one by spore formation, and the other by binary fission.

XIII

PATHOGENIC BACTERIA—*Continued*

The Habitat of Pathogenic Bacteria.—The bacteria that cause disease in human beings grow best in the tissues of human beings and other warm-blooded animals. Some of these pathogens will grow only in the tissues of human beings.

The bacillus of anthrax is common cause of disease in sheep and cattle. It may also cause very serious disease in careless persons who handle infected animals, or their skins or wool. The bacillus of glanders frequently causes disease in horses and cattle. The men who handle such animals are often infected. The bacillus of bovine tuberculosis causes tuberculosis in cattle. Sometimes the disease is conveyed to children through milk infected by the bovine bacillus.

There is evidence that the bacillus of avian tuberculosis (tuberculosis of birds) does not commonly cause tuberculosis in other animals; and that the bacillus of reptilian tuberculosis does not commonly cause tuberculosis in animals that are not reptiles. There are numerous other bacteria that will grow in animals but not in humans.

The tubercle bacillus that infects human beings will not infect any of the cold-blooded animals. It will cause disease in monkeys, and various other warm-blood animals. Dr. Harris, Director Bureau of Preventable Diseases, reported that there were 32,048 cases of tuberculosis registered in his bureau at the end of 1918. Each year about 10,000 persons die of that disease in New York City. In 1915, in the area of registration, there were reported 98,194 deaths from tuberculosis, all forms. The bacillus of typhoid fever, the coccus of gonorrhea, and the spirillum of cholera seem not to affect other than human animals. The bacillus of typhoid fever causes disease in from 300,000 to 500,000 people in the United States every year. The gonococcus makes more

babies blind than any other cause. The spirillum of cholera has been kept out of the United States for some years. It has cost this country thousands of lives and millions of dollars. It is common cause of disease in South America, European and Oriental countries. The bacillus of diphtheria infects children by preference. It may also infect puppies, kittens, horses and mice. Over 10,000 died of diphtheria in the area of registration in 1915.

Some pathogenic bacteria will grow in any of the human organs and tissues. Others seem to be limited to certain organs or tissues. The tubercle bacillus, the pus coccus and the pneumococcus (the cause of lobar pneumonia) may grow anywhere in the tissues. While the tubercle bacillus may grow in any of the organs it grows most commonly in the lungs and bones. It grows least commonly in the muscles. The pneumococcus, in the same way, grows more commonly in the lungs. The bacillus of diphtheria grows oftener on the surface of the throat and the nose than anywhere else. The diplococcus of meningitis grows best in the membranes that cover the brain and spinal cord. Other pathogenic bacteria have their "preferences" for special tissues. These facts explain why we have diseases of different organs —as diseases of the lungs, or the brain, or the bones.

Avenues Through which Bacteria Gain Access to the Tissues.— Normal healthy body tissues contain no bacteria. Most bacteria can not pass through the normal skin. Many of them can not pass through the normal mucous membranes. The mucous membranes line all the cavities of the body which are connected with the exterior. This includes the mouth, stomach, intestines, nose, eye, genito-urinary apparatus, etc.

Bacteria may enter the tissues through breaks, wounds, punctures, incisions, lacerations, abrasions and injured regions in the skin and the mucous membranes. These injuries may be microscopic—a bacterium is small—a scratch of a pin, a scratch from a finger-nail, the rubbing of a rough collar or undershirt, the bite of an insect such as the head louse, flea, bedbug, fly or mosquito—any of these may supply an opening for the entry of the pathogen. The congestion in the throat following exposure to cold or the wet may rupture small capillaries and provide an opening for bacteria. A blow on the chest, on the nose, or on the eye may give the same opportunity. Constipation may injure the mucous membrane of the intestine and supply an avenue of entry. Thus they may enter through the outer surface (skin) of the body, or being inhaled, swallowed or otherwise introduced into the respiratory, intestinal, genito-urinary or other openings in the surface of the body, they may enter through breaks in the inner surface (mucous membrane) which lines those tracts, openings and passages.

There are said to be fifty varieties of bacteria in the normal mouth; there are many bacteria under the eyelids, in the nose, in the decayed teeth, on the gums and on the tonsils. The hair of the scalp and body harbors bacteria. The skin holds them in its pores and creases. They are found on the fingers and under the nails. Some of these bacteria may be pathogenic.

Injury of any sort to the skin or mucous membrane may afford an avenue of entry for the bacteria that cause disease. This injury may be so small that it can not be seen. Bacteria are always present waiting to get in.

Conditions Modifying Infection.—After having gained access to the tissues, further growth of bacteria depends upon several conditions. First: It depends upon the virulence of the bacterium. The same variety of bacteria may in one case be extremely virulent, that is, active and strong, and in another case attenuated, that is, weak and inactive. Second: Further development depends on the number of bacteria. Within certain limitations our tissues will destroy all bacteria that reach them. Third: The avenue of infection has a marked influence. Thus, if the tubercle bacillus enters through the mucous membrane or is injected into the tissues, the usual fatal result is probable. If, however, it enters into the skin, the bacteria may be destroyed or limited to the locality in the skin to which they found entry. Fourth: Some tissues destroy all of the organisms of those diseases that reach them. Fifth: The healthy condition of the body determines its resistance. A normal healthy body will be less liable to infection than a weak, unhealthy body. The juices of a normal healthy body destroy bacteria and neutralize their poisons.

After bacteria have gained access to the tissues, the development of disease depends on: the virulence of the bacteria; the avenue of infection, and the healthy condition of the individual. Therefore, keep clean, exercise right, play and rest right, eat right, look after your excretions. In this way you will be more likely to secure healthy tissues and thus better protect yourself from disease.

XIV

PATHOGENIC BACTERIA—*Continued*

The Effects of Pathogenic Bacteria on Human Life.—After having established themselves in the tissues, pathogenic bacteria may cause injury in various ways. In nearly all infectious diseases the pathogenic

causes are found at one time or another in the blood. These organisms may be present in such enormous numbers as to interfere with the various seriously important functions of the blood. Remember: The blood stream brings soluble food, oxygen, water, salts and internal secretions to every one of the millions of tissue cells of the body, and it removes from these cells the waste products and secretions which come from every living cell. The bacteria in the blood may establish themselves in such large numbers at special foci in the tissues as to prevent the normal food supply reaching the tissue cells in those affected parts. Being thus robbed of their food, those cells will die, or at least be seriously injured. The presence of enormous numbers of bacteria in sensitive and delicate organs may easily cause injury by obstructing small vessels or by pressure on nerve endings. The more important and serious effects of the pathogenic bacteria are caused by their vital activities.

During the life of a great community of many billions of bacteria within the human body the following must take place: (1) These bacteria need food. They may destroy tissues and tissue products in order to satisfy their hunger. (2) Such bacteria manufacture secretions. (3) They must give off excretions. (4) They must form and give off waste products. (It is not possible to separate secretions, on the one hand, from excretions and waste products on the other, except in theory. We know that these several products exist but we can not always separate them from each other.) (5) They die and their dead bodies are dissolved by the action of the tissue fluids. (6) From these excretions, waste products, excretions and dissolved dead bodies, numerous injurious chemical substances arise. There are known to be formed in this way various poisonous acids, bases and salts, among which are a number of powerful toxic chemical substances of very great pathogenic importance. Many of these chemical bodies are known as "antigens." The toxin of the diphtheria bacillus is perhaps the best known bacterial poison. (7) All the products that go into solution are likely to be carried by the blood to all the tissue cells of the body. These floating chemicals irritate the tissue cells so they produce new soluble "defensive" chemical bodies of their own. These chemical bodies are known generally as "antibodies." An "antigen" is a chemical body that causes the production of "antibodies." (8) The chemical reactions between the products of bacterial activity and the products of cellular activity may result in new injurious chemical compounds.

During an infection by pathogenic bacteria we have, then, local mechanical injurious effects and local and general toxic (poisonous) chemical effects. And so we have, in these infections, aches and pains,

headache, delirium, paralysis, unconsciousness, nausea, vomiting, chills, fever, rapid breathing and rapid pulse. Some diseases leave us with blind eyes, deaf ears, crippled hearts, useless kidneys, stiff joints or a damaged mind. Death is by no means the worst injury pathogenic bacteria may cause in man.

Final Results of Infection with Pathogenic Bacteria

Some infections are notoriously fatal. (1) 800,000 persons died of cholera in Russia in 1892. (2) Over 98,000 persons died of tuberculosis in the area of registration in 1915. (3) Over 8,000 people died of typhoid fever in the area of registration in 1915. (4) Over 7,500,000 human beings died of bubonic plague in India between 1890 and 1915. (5) At one time over 40 per cent. of children infected by the diphtheria bacillus died. Now, with treatment by antitoxin, the rate is less than 9 per cent.

There are other serious bacterial diseases which might be listed here. On the average about 1,700 persons die of infectious disease every day in continental United States. The majority of these deaths are caused by bacterial infection.

A number of these infections leave the individual crippled in mind or body. Diphtheria may leave paralyzed nerves. Typhoid fever may leave bad kidneys or a weak heart; meningitis may leave blind eyes or deaf ears; gonorrhea often leaves sterility, blind eyes or crippled joints.

The majority of persons in good health recover from their first attacks of infectious disease. These recoveries are due to the fact that the tissue cells of the human body have the power of manufacturing specific defenses against various infections (antibodies, etc.).

Elimination of Pathogenic Bacteria from the Human Body

During an attack of bacterial disease and sometimes for long periods after, the specific bacteria that caused the disease are expelled from the body in enormous numbers, by way of the various avenues of excretion. In fact, the several excretions always contain pathogenic organisms even in health. The organisms that cause disease of the air passages are expelled largely by way of the nose and the mouth. Some of these organisms are swallowed and escape along with the intestinal excretions. The organisms that cause disease of the intestinal tract are expelled by way of the bowels. The organisms that cause disease of the genito-urinary tract are expelled by way of discharges from that tract.

The Carriers of Disease.—Any agent that brings these pathogenic bacteria to human beings becomes thereby a carrier of disease. The source of nearly all human infection is the human carrier. Pathogenic bacteria may be transferred from one human being to another by direct contact. The most typical examples of infection by direct contact are found in the sexual transfer of venereal diseases. Pathogens may be transferred a little less directly through "droplet infection," that is, by way of the fine spray of mucous and saliva that accompanies coughing, sneezing, etc. The transfer may occur by way of infected food, water and articles in common use. Several insects which feed and breed in human excretions or feed on human blood are known to be carriers, *e.g.*, the mosquito, the fly, the louse and flea. Some animals may serve as carriers, *e.g.*, the cat, the dog, the rat.

XV

THE PROTOZOA THAT INJURE HEALTH

The protozoa are very small animals. Some of them are large enough to be seen by the naked eye, but most of them may be seen only with the help of a microscope. There is evidence that some of the disease organisms that are small enough to pass through the fine pores of porcelain bacteriological filters are protozoa.

The protozoa are simple one-celled animals. The bacteria are simple one-celled plants. All of the functions, all of the activities, all of the work of these animals are performed by the one simple cell of which each is made. In the higher animals, for example the human animal, the work of living is divided between the millions of specialized cells which, taken together, form the animal body. Thus, our muscle cells do our heavy work; our nerve cells do our feeling, seeing, smelling, tasting, directing and thinking. A nerve cell that assists in the complex function of seeing has no part in the function of smelling. Every cell is a specialist. But in the protozoa, the one microscopic cell does all the things that protozoa are able to do.

One of the most typical of the protozoa is the ameba. The ameba under the lower power microscope looks like a dirty gray drop of water. When it eats, it flows around the food particle that happens to be in its way. It does not seem to have any particular mouth part. This curious way of eating is called "phagocytosis." It is characteristic of amebas. It is also characteristic of the white blood cells and certain other cells of the human body. When it excretes, the particles excreted seem to be thrown out anywhere through the surface of the ameba. It

travels very slowly by simply flowing along much as a drop of water might if it could push out a tiny projection in any direction and then flow into the little projection. This curious way of moving about is called "ameboid motion." It, too, is characteristic of the white blood cells and certain other cells of the human body. We will have more to say about these white cells at another time.

The protozoa are not so uniformly alike as the bacteria are. They are all one-celled but they differ in many ways. For these reasons it is hard to describe the protozoa. About seven thousand species of protozoa have been described.

The protozoa live in sea water, fresh water, damp soil, vegetable matter and animal matter.

These organisms reproduce by simple division, by sexual conjugation, and by spore formation. They multiply quite as rapidly as bacteria do.

Some forms of protozoa pass through certain stages of growth in regular sequence, so that from time to time the appearance of the protozoa changes most remarkably. This typical and regular sequence of changes in the case of any given protozoan is called the "life cycle" of that protozoan.

The life cycle of the malarial parasite, for instance, is made up of a cycle of development which includes a period of development in the red blood corpuscle of the human and a period of development in the stomach and salivary pouches of the mosquito. Other protozoa have even more complex cycles than this. A knowledge of these cycles is of great importance in our warfare against the protozoa that cause disease.

The pathogenic protozoa require special surroundings. These surroundings must be of the right temperature, moisture and darkness and must contain the requisite food. So far as we know the protozoan of malaria will live nowhere else than in human blood and in the body of the mosquito; the trypanosome of sleeping sickness will live nowhere save in warm-blooded animals and certain biting, blood-sucking flies; the protozoan of smallpox only in humans and cows (monkeys also).

Protozoa are destroyed by drying; by high and low temperatures; by sunlight and by any radical change in their natural environment.

Relation of Protozoa to Human Health

Protozoa are grouped into pathogenic protozoa and non-pathogenic protozoa. It is possible but not probable that under special conditions the pathogenic forms may become non-pathogenic, and the non-pathogenic, pathogenic.

The Malarial Parasite.—Malaria is caused by an animal parasite which is called the plasmodium of malaria. This plasmodium is so small that it can be sucked through the capillary bore of the proboscis of a mosquito—so small that hundreds of them may grow in the stomach of a mosquito; so small that hundreds of them may live in the salivary pouches of a mosquito waiting to be squirted into human tissues when the mosquito feeds on human beings. It is so small that it can enter the red blood corpuscle (there are 4,000,000 red blood corpuscles in a cubic millimeter of blood with plenty of room to spare) and multiply in the red corpuscle until there are a score or more of the young parasites produced in that single red cell. The parasite of human malaria grows only in the human being and in the anopheles mosquito. Without the mosquito or the human, the parasite could not live. Malaria is a common disease. Malaria is never caused by anything else than the plasmodium of malaria. Malaria is transmitted through the mosquito. Without the mosquito there would be no malaria. The only mosquito that carries this parasite is the anopheles mosquito.

The trypanosomes form another important group of protozoa, some members of which cause serious disease. The disease caused by these organisms is called trypanosomiasis. Infections from different trypanosomes occur in South America, Africa, Southern Europe, Persia, India, Burma, China and the Philippines. Many kinds of animals are affected as well as man. A typical trypanosome is a very small, elongated, flattish animal looking something like an eel. It has a flagellum or hair-like process on one end and a finlike membrane extending from the flagellum along the whole length of the body. Its movements are very active. These organisms live and multiply in the blood of animals and man. Life cycles have been described for them. The only disease of human beings caused by these organisms is sleeping sickness or human trypanosomiasis. It is caused by a specific trypanosome which is called the Trypanosoma Gambiense. The organism is carried from man to man or from animal to man by the tsetse fly, and perhaps other blood-sucking flies. Up to the present time they have been found alive only in the blood of human beings and some animals, and in the stomach and sucking apparatus of the tsetse fly. This disease is limited to the regions occupied by these flies, which limitation at the present time confines the disease to parts of Africa. Here the disease is a terrible scourge and produces a most serious and fatal sickness.

The ameba is another protozoan, some forms of which cause disease. Amebic dysentery has been found more or less all over the world, particularly in tropical and sub-tropical countries. The ameba is a microscopic organism of very considerable biological interest. I have described it to you rather inadequately in the earlier part of this lecture. I advise you to consult a book on biology or zoology for further information. The chief carrier of this organism is drinking water which has been contaminated by the excretions of persons or animals sick with the disease. The disease itself is very uncomfortable and painful. Many patients die. The endameba buccalis is thought to be the cause of pyorrhea dentalis, a very common and a very important disease of the gums.

The spirochæta pallida, or the treponema pallidum, is probably a protozoan. This spirochæta is very small, but is larger than the average bacterium. It is long and slender, shaped like a thread, though somewhat broader. It has a curious spiral movement. We have only recently been able to cultivate these parasites for laboratory study, so that we have much yet to learn about them. The spirochæta pallida or treponema pallidum is found in the blood, tissue juices, secretions and sores of syphilitic victims. It is the cause of syphilis, discovered in 1905 by Schaudin and Hoffman. This organism is transmitted by intimate contact as in sexual intercourse, drinking from contaminated cups, eating with contaminated spoons, smoking the pipe of a syphilitic individual, etc. Syphilis is always derived from some one who has the disease. It may come through some innocent medium—a cup, a pipe, a drink, a kiss. It has destroyed more children, crippled more men and women, ruined more homes than you can imagine. It is one of the most common and most serious diseases of civil life and in military life it sometimes does more damage than the weapons of war. It is most frequently secured through illicit sexual intercourse but may be spread by contact from husband to innocent child; from guilty brother to innocent sister, mother or friend.

XVI

THE PATHOGENIC METAZOA, OR THE MULTICELLULAR ANIMAL PARASITES THAT CAUSE DISEASE

This group of agents that cause disease includes a number of higher animal parasites, their eggs, embryos and larvæ. The more important members of the group are the flukes, tapeworms and their larvæ (bladder worms), hookworms and other round worms.

The Frequency of Parasites.—There is no species of animal and no race or class of men known to be free from parasites. (Stiles.)

Influence of Parasites Upon Their Hosts.—The injury done may vary with species, size, location and the number of parasites and with the condition and age of the host. This injury may be accomplished in various ways: Nourishment is taken which should go to the host; blood is taken by the parasite for food; mechanical pressure irritates or causes atrophy of organs or parts of organs; natural channels may be obstructed; the wandering of the parasite may cause irritation; substances may be excreted which have a toxic influence and which may change the condition of the body fluids; injury to the intestinal mucosa or to the skin may form points of entrance for bacterial and protozoan infections.

Trichinæ

Description.—The adult worm lives in the upper part of the intestine. The male is 1.4 to 1.6 mm. long and 40 u. in diameter. The female is 3 to 4 mm. long and 60 u. thick.

The female lives in the lumen of the intestine or bores into its walls and deposits her young during a period of five or seven weeks. Each female produces about 1,500 embryos in that length of time. These embryos are considerably smaller than the adult organism. They wander with the lymph or blood to the striated muscles. Here they locate and develop into "encysted larvæ" or, as they are commonly called, "flesh worms."

These encysted larvæ remain alive and lie curled up in the muscle for years. This larvæ stage is the infective stage. When meat containing these larvæ is eaten, the cysts are destroyed in the stomach and the larvæ pass into the small intestine and develop there into adult forms.

Carriers of Trichinæ.—Humans, hogs, wild boars, rats, dogs and cats are affected by the disease and contain the encysted larvæ in their tissues. The hogs may carry the disease to human beings. The hogs, rats, dogs and cats carry the disease to each other.

The Disease of Trichinosis is always uncomfortable, frequently serious, and occasionally fatal. It is not a common disease. A small outbreak of trichinosis occurred in the Borough of Queens in February, 1916. Twelve persons were treated at St. Joseph's Hospital. In spite of the best of care four of the patients died.

Tapeworms

Man becomes afflicted with tapeworms by eating flesh containing the encysted larvæ of the parasite or by eating food that has been contaminated by the excretions of dogs, cats, rats, mice, or by transferring the eggs directly to his mouth on his fingers.

Some tapeworms grow as long as thirty feet. Others are only a few millimeters in length. They grow in segments and are flattened. The head end contains suckers and in some forms is armed with hooks.

Tapeworm disease is caused by eating the larvæ of tapeworms in insufficiently cooked beef, pork and fish. Tapeworms of less common occurrence may be secured from dogs and rats by handling them and transferring the eggs on the fingers to the mouth or by eating food they have contaminated. One tapeworm is liable to lay 150,000,000 eggs a year, so that the chance of spreading the disease is not to be underestimated. People who carry tapeworms are usually starved. They lose weight, become thin, emaciated, and, if unrelieved, may die. Cook your meats thoroughly; never eat them raw.

Hookworm

The Hookworm is an animal parasite of about the size and shape of a slightly bent pin. There are two well-known hookworms—the old world hookworm and the new world hookworm. They are very much alike. The young hookworm develops from eggs that have been cast out in the fecal discharges of human beings sick with hookworms. These eggs hatch if they chance to be left in warm, moist surroundings. After a few weeks the young hookworm is ready to attach itself to its human victim. If the young worm happens to have developed in dejections that were cast in or near a vegetable garden it may be carried to the table in green food such as celery, radishes, lettuce and the like. If a bare-footed human walks through the grass in which there are young hookworms, the little worms may get on his feet, bore through the skin and thus find their way by a devious route to the intestinal canal. The adult life of the hookworm that is picked up by the human is spent in the intestinal canal of that human. Here the worm fastens itself by means of its sharp teeth into the intestinal wall. It sucks the blood of its provident host and poisons him with its toxic excretions.

The great majority of our Southern farms have no privies. The great majority of our Southern country folks go barefooted. The great majority of our Southern country people are not careful in their habits of hygiene. And so the great majority of our Southern rural

population have hookworms. The hookworm belt reaches from 30 degrees south latitude to 36 degrees north latitude and goes around the world. It holds over 400,000,000 persons affected with hookworm. Those people are injured physically, mentally and morally. They are educationally and economically depressed or paralyzed.

Whenever people suffering with hookworm are persuaded to undergo treatment and to practice habits of good hygiene, their disease disappears, and they often become wide-awake, useful citizens. The Rockefeller Foundation has proven the value of hygiene most dramatically in the hookworm sections of our Southern States.

XVII

CAUSES OF CANCER

Cancer is a disease of middle life and later life. It is one of the most hopeless of all the diseases of mankind. Practically every advanced case has resulted in the death of the patient.

The cause of cancer is not known.

Chronic irritations often pass into cancer. Chronic ulcerations, irritated scars, moles, warts, benign tumors, and other irritations of long standing are called precancerous conditions because they frequently develop into cancer. We do not know why they develop into cancer.

Cancer may be produced in some of the lower animals by inoculating them with cancerous tissue from other animals.

Cancer has been produced in rats that have been fed with cockroaches in which certain intestinal parasites were present.

Cancer in mice is more likely to reappear in mouse families in which it has already appeared. We have no proof that human cancer is inherited.

Fish and dogs have developed cancer when fed on scrapings from aquaria in which fish with cancer had been living.

Sarcoma has been produced in chickens by inoculating them with a filtered emulsion of sarcomatous material taken from other chickens. These and other animals will undoubtedly enable us finally to discover the cause and the cure for cancer and other like malignant growths.

Precancerous conditions are dangerous. Take good care of all ulcers, wounds, scars, moles, warts and other irritations. Cancer is on the increase. Fifty-four thousand persons died of cancer in the area of registration in 1915.

XVIII

THE UNKNOWN AGENTS THAT INJURE HEALTH

We do not know the causes of the following diseases: Smallpox, chicken-pox, scarlet fever, measles, mumps, yellow fever, rabies, Rocky Mountain fever, trachoma and break-bone fever. There are other diseases in this group.

Our ignorance concerning the causes of these diseases may be due to: (*a*) Lack of technique. Our knowledge of micro-organisms depends upon our ability to bring them into view; cultivate them and experiment with them. We must isolate a disease cause before we can make a study of it. (*b*) Many of these causes are too small to be seen with power of magnification now at our disposal. A study of filterable viruses began in 1898. We know that the causes of the following human and animal diseases are so small that they will pass through bacteriological filters. We call such organisms filterable viruses, ultramicroscopic viruses or filtrate viruses.

The Filtrate Viruses

Diseases of domestic animals: Pleuro-pneumonia of cattle; African horse sickness, sheep-pox, cattle plague, hog cholera, swamp fever of horses, infections agalactia (sheep and goat), catarrhal fever of sheep, distemper of dogs, infectious stomatites papulosa of cattle, guinea pig epizotic, a peculiar paralysis of guinea pigs, and a rat disease.

Diseases common to man and animals: Foot and mouth disease, rabies vaccinia and smallpox.

Diseases of man: Yellow fever, molluscum contagiosum, dengue, fever, verruca vulgaris, trachoma, sand-fly or three-day fever, poliomyelitis, typhus fever, trench fever, measles and scarlet fever.

Diseases of birds: Fowl pest, fowl diphtheria, chicken sarcoma.

We know very little about these minute causes of disease, but our knowledge is on the increase. At present we know: (1) That some of these diseases are carried by biting insects such as the mosquito, the fly, the louse and the tick. (2) That others are introduced through grosser injuries as in rabies. (3) That some of these diseases are transmitted by contact. (4) All of these disease causes are destroyed by high temperature, some of them more easily than the bacteria. (5) Some of them are more resistant to drying than bacteria are. (6) They resist cold. (7) A few have been cultivated in the laboratory. (8) The extreme minuteness of some of these disease causes, combined with their resistance to drying, may account for their contagiousness.

"Minute particles suspended in air or in liquid obey the laws which govern the diffusion of gases and substances in solution in liquids." (Wollbach.)

XIX

LAST HEALTH TALK

Summarize the objects of the term's work in Hygiene (see Chapter I).

(*a*) Aim and usefulness of student health examinations. Present statistics as to teeth, vision, etc., of this class. Point out that "habits" of health examination and physical repair may be formed and urge their continuation.

(*b*) Health protection through the avoidance of the causes and carriers of disease. The "floor talks" this term have indicated ways and means of securing health protection.

(*c*) Wise habits of daily life have been emphasized in these floor talks (nourishment, excretion, work, exercise and recreation, and rest).

(*d*) What have you done for the man you are to be? Have you wasted his opportunity? Have you neglected his training? Will he be bigger, stronger, and more vigorous because of your care this term? Will he be sick less, will he be more useful, will he live longer and will he be happier? You are master of the man you are to be—will he thank you or blame you?

GENERAL HYGIENE

PART TWO

THE CARRIERS OF DISEASE

I

INTRODUCTORY

Every young human owes it to himself and to society of which he is a part, to get ready for the duties and the experiences of citizenship. You as college students have a greater obligation to be prepared because of the educational opportunities that are open to you. As sons of the city and as matriculates of the city's college you have not only an obligation—you have in addition a responsibility. Your obligation is to make yourselves physically fit; to make yourselves physiologically sound; and to make yourselves vigorously and enduringly healthy. Your responsibility is to use your educated body and your educated mind to meet fully, completely and intelligently the demands of citizenship in peace or in war for the lasting benefit of your country, your State, your city, and yourself.

Your State and your city have provided opportunities in this college for your training. The college will do its utmost to give you the best service it affords—but the success of your training here depends upon you. After all has been furnished that can be furnished by the college and by the city and the State back of the college, you and you alone can make your training season here a success.

The Department of Hygiene is concerned with your health—the most important asset you can possess. If you will make intelligent use of the opportunities provided in this department you will aquire habits of health information, habits of bodily care and repair, habits of health protection, and habits of constructive hygiene that will enable you to achieve and conserve your full growth and full bodily development, and to acquire a vigorous health resource that will conserve your productive life for service to yourself and for service to society.

One of the very important problems of health protection is the problem of avoiding the carriers of disease. Every plan for the aquisition and the conservation of individual health and of community health must include wise provisions for the destruction, isolation, and avoidance of pathogen carriers. The health talks of this term will be concerned with these carriers.

These talks will be worth while if you will make them your own. They will be useful if you will make health habits out of them. Their

service for the protection of your health and for the conservation of your vital resources depends wholly upon you. They will help you meet your obligations and carry your responsibilities to the citizenship for which you are getting ready if you will use them.

II

MAN AS A CARRIER OF PATHOGENS

When we remember that only a few pathogenic organisms reproduce in nature, and that all forms under favorable conditions will live and reproduce in the human body, we are forced to the conclusion that man himself is the most important and the most dangerous disease carrier.

Man is a carrier of disease because of the pathogenic organisms which he distributes about him by way of his various excretions in health, in disease, and during recovery from disease. The relation of these various excretions to the spread of disease may be outlined as follows:

Dissemination of Pathogenic Organisms by Way of the Excretions and Discharges from the Human Nose and Throat

(*a*) *In Health.*—Pus cocci, the organisms that cause boils and abscesses; streptococci, the organisms that cause severe inflammation with general toxemia (poisoning); pneumococci, the organisms that cause one form of pneumonia. They may cause other diseases than pneumonia. Diphtheria bacilli. During a certain epidemic in Middletown, Conn., over 2 per cent. of the throats of 4,081 apparently healthy individuals showed diphtheria bacilli. After the epidemic subsided over 1 per cent. of these individuals showed diphtheria bacilli. The cocci of meningitis have been found in apparently normal persons. The cause of infantile paralysis has been found in apparently normal throats. It is possible that the specific causes of the following diseases may be present in the air passages of healthy persons: Scarlet fever, measles, whooping-cough, mumps, leprosy, and tuberculosis.

(*b*) *In disease* of the nose, mouth, throat, and other upper air passages, and lungs. The organisms that cause colds in the nose, throat and lungs; influenza; bronchitis; the various sorts of pneumonia; syphilis; diphtheria; infantile paralysis; leprosy; tuberculosis, and bubonic plague. The unknown cause of measles, scarlet fever, and other diseases.

(*c*) *During recovery from disease* of the respiratory tract, and

often for some time afterward, the various organisms noted under (*b*) are eliminated in the excretions from the respiratory tract. Note the importance of this fact.

III

MAN AS A CARRIER OF PATHOGENS—*Continued*

The Dissemination of Pathogenic Organisms by Way of the Excretions and Discharges from the Nose and Throat.—(Continued)

Methods of Elimination—These organisms are carried out of the body in health and disease by sneezing, coughing, spitting, blowing the nose, forceful talking, forceful whispering, forceful breathing, and by swallowing.

Methods of Transmission.—The causes of disease contained in these discharges from the nose and mouth in health and in disease reach other people. (*a*) *By direct transmission* of organisms from one person to another, such as by droplet infection, in coughing, sneezing, and other forms of forceful breathing; by contact infection, as in kissing; contact with dirty fingers or other parts that have been smeared with these discharges; common spoon; apple core; the mother that chews her baby's food or feeds it with her own spoon; cigar-makers that use their own saliva in rolling cigars, etc. (*b*) *By indirect transmission* by way of infected: Dust, food and drink, articles in common use, household vermin, such as rats, mice, flies, water-bugs, fleas, bed-bugs, lice, etc.

Conditions favorable to the transmission of pathogens from one person to another by way of the excretions and discharges from the nose and mouth are found in (*a*) Crowded living quarters. (*b*) Crowded transportation facilities. (*c*) Army camps, trenches, transports, etc. (*d*) Groups of people gathered for any purpose. (*e*) Wherever careless people are found.

The importance of the human being as a carrier of disease through the dissemination of his nasal and oral excretions and discharges is made evident by the following facts: (*a*) This is practically the only way in which most of these diseases are spread from one person to another. (*b*) These diseases represent an enormous amount of human misery, suffering, and loss of life. There are always 3,000,000 people sick in these United States. Seventeen hundred people die every day. At least half this sickness and half these deaths are due to diseases spread by human beings in this manner. For example: (1) In New

York City each winter there are at least 15,000,000 cases of common cold. (2) In New York City each year there are 50,000 cases of tuberculosis, with from 8,000 to 10,000 deaths. A large number of these are cases of pulmonary tuberculosis.

IV

MAN AS A CARRIER OF PATHOGENS—*Continued*

Dissemination of Pathogenic Organisms by Way of Discharges from the Ears and Eyes

There are no pathogenic organisms discharged in this manner *in health*. The middle ear and the eye drain into the nose, so in disease the ear may be affected by various pus organisms and by any of the organisms that cause disease of the nose and throat. *In disease* the important pathogenic organisms that are found in the discharges from the eyes are the cause of pink eye; the gonococcus; the cause of trachoma; any of the organisms that cause disease of the nose.

Means of spread of disease from these sources are towels, handkerchiefs, etc., fingers, contact.

Importance of these discharges.

Dissemination of diseases by way of discharges from the intestinal tract. The pathogenic organisms eliminated in this manner are:

In health (apparent or real). The colon bacillus is the most common inhabitant of the lower intestine. Not an actively pathogenic organism. It not infrequently becomes virulent. Present in the intestinal canal normally. The bacillus of typhoid fever has been found in the feces of apparently healthy individuals who have no history of typhoid. One investigator has isolated forty-four varieties of bacteria from forty-eight specimens of feces. Most of these forms are nonpathogenic. They include the bacillus pyrocyaneus, bacillus aerogenes capsulatus, bacillus of tuberculosis, bacillus subtilis, and other forms that are known to be pathogenic. The *ameba* is sometimes present. The *hookworm* frequently is present without symptoms. A number of *less common higher-animal parasites* have been found in the feces of human beings who are apparently well.

In disease. The number and variety of bacteria and protozoa is enormously increased in intestinal disease. The bacteria present may be forms already there, such as the bacillus of typhoid fever; the spirillum of cholera; the bacillus of dysentary; the tubercle bacillus. The animal

parasites present may be the ameba, the treponema of syphilis, the tapeworm, hookworm, various other parasites.

In recovery from disease, and for a greater or lesser time afterward. Probably all the organisms that cause intestinal disease. The bacillus of typhoid has been found fifty-five years after recovery of the patient.

V

MAN AS A CARRIER OF PATHOGENS—*Continued*

The Dissemination of Pathogenic Organisms by Way of the Discharges from the Intestinal Tract.—(Continued)

Methods of Elimination of Pathogenic Organisms from the Intestinal Tract.—In the feces. One-third of the weight of the dried feces passed by the normal individual is made up of bacteria bodies. (Stengel.) The average normal daily output by way of the bowels is estimated at 128,000,000,000 bacteria. (Strasberger.) Ninety-nine per cent. of the bacteria in normal feces are dead, but the remaining 1 per cent. may amount to many hundred millions of live bacteria. In disease the output of bacteria in the feces is enormously increased. The tapeworms, hookworms, and other animal parasites reproduce in the intestinal canal, and their eggs or offspring are then discharged in the feces. A single tapeworm may lay 150,000,000 eggs in a year.

Methods of Transmission.—The pathogenic organisms contained in the feces are conveyed to other people as follows: Directly through contact with soiled hands or other parts of the individual. Indirectly through infection of food, water, articles in common use, and infection of food animals, household pets, vermin.

Conditions favorable to the transmission of disease from one human being to another by way of the feces. (*a*) Bad habits of personal hygiene. (*b*) Poor sanitary conveniences. (*c*) Bad hygiene of food animals. (*d*) Warm, moist weather. (*e*) Bad domestic and community sanitation. Note the ease of transmission in trench warfare and careless camp life.

Importance of the human being as a disseminator of disease through his fecal discharges. If man would so handle the excretions from his bowels that they would not get into the food and drink of animals or other men, there would soon be no more typhoid fever, no more cholera, no more tapeworm, and no more hookworm. There were 350,000 people sick with typhoid fever in the United States in 1914. This means that human feces (or urine) had polluted the food or drink of

350,000 human beings. Thirty-five thousand died. There are to-day 800,000,000 men, women and children in this world sick with hookworm. And every case has come from contact directly or indirectly with human feces. New York City has a sewer system, but flies, insects, cats, dogs, and vermin may carry their burden of disease organisms from the outlet of the sewer to your pantry and to your table. Importance of sanitary latrines in camp life and in the trenches.

VI

MAN AS A CARRIER OF PATHOGENS—*Continued*

The Dissemination of Pathogenic Organisms by Way of the Genito-urinary Discharges

The pathogenic organisms eliminated in this manner are: *In health:* Pus organisms. *In disease:* Bacillus of typhoid fever; the gonococcus; the treponema of syphilis; the bacillus of tuberculosis. *After certain diseases* (after "recovery"): Gonococcus; treponema of syphilis; typhoid bacillus.

Methods of elimination.—Through urinary and genital discharges.

Methods of transmission.—By direct transmission: Contact; soiled fingers; sexual intercourse. By indirect transmission: Contamination of food and drink; articles in common use; animal and insect carriers.

Conditions favorable to transmission of disease by these routes: Poor hygiene; bad sanitation; bad community morals; military temptations and practices.

Importance of the *human being as a transmitter* of disease by way of his genito-urinary discharges: (*a*) importance of typhoid. (*b*) Importance of gonorrhea and syphilis. It is impossible to fully appreciate or state the importance of these venereal or so-called social diseases. They are pandemic. No country in the world is free from them. This has been true ever since the pandemic of the fifteenth century when syphilis broke out in its most hideous form in all parts of Europe. Here in New York City investigators tell us that a great many men and boys visit prostitutes every day. Every man and every boy that makes this his practice will sooner or later have syphilis, or gonorrhea, or both. There must be hundreds of thousands of persons suffering with these diseases in New York City. It has been shown in some armies in active warfare that more men have been incapacitated by venereal disease than by their human fighting enemies. The fighting strength of an army may

be reduced 20 per cent. or 30 per cent. by venereal disease unless safeguarded. (Statement of the American Social Hygiene Association, summer of 1917.) The importance of gonorrhea and syphilis arises from the following facts: (1) These diseases are universal. (2) They are associated with sin, shame, and crime. (3) They ruin the family and the home. (4) They are passed on from the guilty to the innocent. (5) Gonorrhea makes men sterile, unable to become fathers; women sterile, unable to become mothers. (6) Syphilis destroys more young and unborn infants than any other cause. (7) Gonorrhea makes more children blind than any other cause. (8) Syphilis places more men, women, and children in asylums for the insane and feeble-minded than any other cause, with the possible exception of alcohol. (9) Syphilis cripples the brain, the nerves, and the muscles. Gonorrhea cripples the joints. Both these diseases deform and incapacitate men, women, and children, mentally, morally, and physically. (10) They destroy individuals, ruin homes, demoralize communities and defeat armies.

Don't Forget.—These diseases are caused by living organisms which will grow only in human beings. These organisms are distributed from one human being to another most commonly through contact with genito-urinary excretions. The most common carrier of these diseases is the prostitute and the man of loose morals.

VII

MAN AS A CARRIER OF PATHOGENS—*Continued*

Dissemination of Pathogenic Organisms by Way of the Skin

The skin may mechanically carry certain organisms which live on it or in it. The most important of these organisms are pus cocci; streptococci; pathogenic contaminations from discharges from the eyes, ears, nose, mouth, rectum, genito-urinary tract, and infected wounds of the skin; and various parasitic insects.

Certain pathogens have been found in sweat, *e.g.*, the typhoid bacillus and the tubercle bacillus. Probably not common.

Certain organisms that live in the blood may be drawn through the skin by blood-sucking insects. Some of these organisms and the insects that carry them may be enumerated as follows: (*a*) The plasmodium of malaria. May be present without symptoms. Carried by the anopheles mosquito. (*b*) The cause of dengue, carried by a mosquito. (*c*) The cause of yellow fever, carried by a mosquito. (*d*) The filaria.

There are several diseases caused by filaria. Most of them are unimportant; carried by a mosquito. (*e*) The trypanosome of sleeping sickness, carried by certain biting flies. (*f*) The cause of typhus fever, and the cause of trench fever, carried by the louse. (*g*) The bacillus of bubonic plague, carried by fleas. (*h*) The unknown cause of Rocky Mountain or spotted fever, carried by a tick.

Opportunities for blood-sucking insects to draw pathogens from the blood. (*a*) Organisms present in the blood in health. Cases are recorded in which malaria parasites have been present with no symptoms. Filaria usually infect with no apparent injury or discomfort to their victims. (*b*) Organisms present in the blood in disease. In addition to the pathogenic organisms noted above which locate themselves in the blood there are periods during infection from many other organisms during which they are present in the blood. Typhoid bacilli, tubercle bacilli, treponema of syphilis, gonococci, and other organisms have been demonstrated in the blood of patients. (*c*) Organisms that persist in the blood after recovery of the patient. Probably few in number. The malaria parasite may persist occasionally.

Methods of elimination.—The insects puncture the skin and suck blood containing pathogenic organisms. These organisms may simply remain alive in the puncturing apparatus or stomach of the blood-sucking insect; or they may pass through a cycle of development in the insect.

Methods of dissemination.—The insect carrier either mechanically contaminates the food of human beings, or injects the pathogenic organisms it carries into the blood of the next person it bites, or deposits pathogens on the surface of the skin.

Conditions favorable to transmission..—Congestion and poor personal hygiene favor bed-bugs, lice, etc. Bad community sanitation favors mosquitoes and flies. Poverty, because it is often accompanied by vermin. Mexico, between 1893 and 1913, has a record of 56,719 cases of typhus fever with 14,758 deaths. Army life during periods of active service favorable to vermin, such as body lice. Typhus fever one of the important diseases of armies. The Great War reported epidemics in Turkey, Servia, Russia and other countries. Trench fever, a product of the Great War.

Importance of human being as a disseminator of disease by way of the skin.—Malaria: 2,000,000 cases a year in the United States; 12,000 deaths. Yellow fever: In 1878 there were 132 United States towns affected, with 15,000 deaths. The epidemic represented the loss of $100,000,000. No epidemics here in recent years. Sleeping sickness has devastated whole sections of Africa, destroying the natives by the

thousand. Typhus fever at one time was the scourge of every army. Bubonic plague is a common epidemic in the Orient, and is accompanied by an enormous mortality.

VIII

MAN AS A CARRIER OF PATHOGENIC ORGANISMS—SUMMARY

I. Man is a carrier of disease because of the pathogenic organisms which he distributes about him in health and disease and after recovery from disease by way of his (*a*) Respiratory tract, including his nose, throat and mouth. (*b*) Eyes and ears. (*c*) Intestinal tract. (*d*) Genito-urinary tract. (*e*) Skin.

II. These organisms may be transferred from one person to another by (*a*) Direct contact ("contact infection"). (*b*) Secondary carriers, such as infected sewage, food, water, air (droplet infection, dust infection), dust, dirt and soil; articles and materials in common use (that is, by more than one person at a time); insects and animals.

III. When we remember that only a few forms of pathogenic organisms reproduce in nature and that all forms under favorable conditions multiply freely in the human tissues, we are forced to the conclusion that man himself is the most important and the most dangerous carrier of disease. In the great epidemics of history he has been the agent that has disseminated such diseases as cholera, typhoid fever, smallpox, yellow fever, syphilis, bubonic plague, and typhus among the nations of the earth.

IX

INSECTS AS CARRIERS OF PATHOGENIC ORGANISMS

General Considerations

The insects that are known to carry the organisms that cause disease are flies, mosquitoes, fleas, ticks, lice, bedbugs, water-bugs (?), cockroaches (?), kitchen ants (?).

In view of the fact that our knowledge of these carriers is only a few years old, we are forced to admit that there may be other insect carriers of whose relation to disease we are not at present aware.

The sources from which insects secure the pathogenic organisms which they carry.

(*a*) In general, it may be said that these sources are the infected

breeding-places and the infected feeding-places of insects. The significant fact in this connection is that human beings and animals are the final sources from which the pathogenic organisms come. These human and animal sources which serve as feeding-places and breeding-places for the insects that may carry the disease are the dead bodies of diseased human beings and animals (uncommon); excretions from men and animals; excretions from persons and animals while sick; excretions from such sources during recovery; excretions from such sources persisting for long periods of time after recovery, *e.g.*, diphtheria, cholera, typhoid fever; excretions from human beings and animals that have not been sick, *e.g.*, diphtheria, other possibilities; the living human beings and animals on which biting and blood-sucking insects feed while their blood contains pathogenic organisms; while the human or animal is sick; during recovery; for long periods after recovery, in some cases, with no evidence of any infection at any time.

(*b*) In particular it may be said that the organisms that cause disease may be picked up by insect carriers in the following common breeding-places and feeding-places of those insects: Garbage which may contain infectious human or animal discharges; the outlets of sewers where human excretions are found; deposits of manure, droppings from cattle, horses, swine, sheep, chickens, dogs, human beings, and other animals; hospital and sick-room wastes; the bodies of dead animals; offal from slaughter-houses, meat markets and food stores; warm, dark, damp and dirty places in which human excretions may have been left by human carriers; the dead bodies of men and animals.

X

INSECTS AS CARRIERS OF PATHOGENS—*Continued*

Ways in which Insects Carry Pathogenic Organisms

(*a*) *Passively.*—The insect that is a passive carrier of disease may carry pathogenic organisms on the outer surface of its body, as in the case of the house-fly that smears its body with the excretions from a case of typhoid fever or pulmonary tuberculosis on which it feeds. It may carry pathogenic organisms in its intestinal canal. The organisms then may pass through and escape with the excretions as in the case of the fly that feeds on the intestinal excretions of a typhoid patient or the sputum of a case of pulmonary tuberculosis.

(*b*) *Actively or Biologically.*—The insect that is an active carrier of disease becomes for a time necessary to the life of the pathogenic

organism. We say then that the pathogenic organism is a parasite and the insect is its host. An example of such an active carrier is the anopheles mosquito, which may carry the pathogenic protozoan that causes malaria.

The distribution of pathogenic organisms by insect carriers. The insect carriers distribute the organisms of disease in the following ways: (*a*) By wiping or shaking them off their bodies while in contact with the food or drink of human beings, or while in contact with articles in common use, or while in contact with human beings themselves. (*b*) By excreting them in their intestinal discharges. The mosquito usually defecates when it stings. The organism that causes trench fever is contained in the defections of the body louse. Various pathogenic organisms have been found in the intestinal canal of the mosquito. Tubercle bacilli have been found in the feces of flies. (*c*) By squirting them into the blood of their victims when they sting them, *e.g.,* the anopheles mosquito and the tsetse fly. (*d*) And possibly, through their remains, which may be smeared on the skin when the biting insect is crushed by a blow from the victim.

XI

INSECTS AS CARRIERS OF PATHOGENS—*Continued*

Special Considerations

Insects that are known to be active or biological carriers of disease:

The Ticks: Dermacentor marginatus.—Carries Rocky Mountain fever, or spotted fever. Bitter Root Valley, Colorado, mortality between 70 per cent. and 80 per cent.

Ornithodros moubata.—Carries "African tick fever," one of the scourges of Africa.

The Biting Flies: The tsetse fly, glossina palpalis and glossina morsitans.—Carry the trypanosome of sleeping sickness discovered by Bruce and Castellani in 1902; an absolutely fatal disease; has destroyed hundreds of thousands of human beings in Africa.

Certain Mosquitoes (culex fatigans, and some others).—Carry dengue or break-bone fever. In 1895, 50,000 out of a population of 65,000 had the disease in Charleston, South Carolina; pain excruciating; no mortality in the otherwise strong. Parasite not certainly known.

Some evidence to show that it goes through a cycle in man and another in the mosquito.

Anopheles culex, panoplites, and other mosquitoes.—Carry filaria Bancrofti. (Manson, China, 1876.) Thirty to 40 per cent. of the South Sea Islanders have filaria in their blood; 10 to 50 per cent. in China. This disease, as a rule, causes no symptoms; occurs in tropical and sub-tropical countries; adult worm lives in human tissue (the lymphatics), a thread from three to four inches long. The embryos or larvæ swim free in the blood and are thus sucked up by the mosquito. The embryo or larva undergoes a cycle of changes in the tissues of the mosquito lasting fourteen days or longer, depending on the temperature.

Stegomyia calopis.—(Reed, Carroll, Agramonte and Lazear, Cuba, in 1910.) Carries the leptospira icteroides, the cause of yellow fever. The United States has lost more lives in the past from this disease than any other country. In 1878 an epidemic affected 132 towns in our Southern States with 15,000 deaths and a loss of over $100,000,000. Texas, 1903, over 1,000 cases. New Orleans, 1905, over 8,000 cases; 900 deaths. Since 1793 the United States has lost over 100,000 lives through yellow fever. Has been a serious disease in army camps. Probably a cycle in man. A cycle of some sort in the mosquito.

Anopheles mosquito.—Carries the cause of malaria. (Major Ross, 1897.) Laveran found the cause. About 2,000,000 cases a year in the United States; 12,000 deaths. Another very important disease in military camps. A cycle of development in man, and a cycle in the mosquito.

Certain Fleas: The rat flea, lemopsylla cheopis.—Carries the bacillus of bubonic plague. Sixth century, one-half of the people of the Roman Empire died from the plague. Fourteenth century, 25,000,000 people died of this disease in Europe; was called "The Black Death." Seventeenth century, 70,000 died in London alone. Oriental pandemic, 1895-1910, and on; 7,500,000 deaths in India during a period of fifteen years. (Martin, *British Medical Journal,* November, 1911.) A disease of historical importance in military campaigns. One of the serious concerns of the camp and naval sanitarian. Bacillus pestis, transferred from rat to rat and from rat to man by the rat flea which feeds on rats and on human beings. Not necessarily an active carrier.

Insects that May Be Passive Carriers of Disease

Cockroaches.—Have been known to carry the bacillus of typhoid fever. The intestinal parasites of certain cockroaches are known to cause malignant growth in rats when eaten by them.

Water-bugs.—Nothing proven, but their habits are bad and their opportunities are sufficient.

House Ants.—In a class with cockroaches.

Lice.—Known to have carried typhus fever. (Body lice; head lice, probably.) Death-rate, 40 to 50 per cent. Known to have carried relapsing fever. Death-rate about 4 per cent. Carriers also of trench fever.

Bedbugs.—Known to have carried spirillum of relapsing fever and bacillus of bubonic plague. The bacillus of tuberculosis has been found in the intestinal canal of this insect.

The Gnat.—Carries the unknown cause of "Adriatic" or "Three-day fever." Death rare.

Fleas.—Chiefly notorious as active carriers. (See above.)

Mosquitoes.—Chiefly notorious as active carriers. Have been found with living tubercle bacilli in their intestines; also bacillus of leprosy.

The House-fly.—In July a single fly has been found to carry on his body as few as 570 and as many as 4,400,000 bacteria; and in his body (intestines) as few as 16,000 and as many as 28,000,000 bacteria.

The following common pathogenic bacteria have been found on the house-fly or in his intestines or in his feces: Bacillus of typhoid fever; spirillum of cholera; bacillus of bubonic plague; the cause of summer diarrhea; bacillus of tuberculosis.

The importance of the filthy habits of the house-fly in the home, the community and specially in camp and trench life. One of the lessons learned through our disgraceful experience in the Spanish-American War taught us that the fly as a carrier of typhoid fever may be more dangerous to a dirty, careless camp than a human fighting enemy.

XII

INSECTS AS CARRIERS OF PATHOGENS—*Continued*

Prevention of Disease from Insect Carriers

Keep pathogens away from insects. Dispose of human and animal excretions and discharges so they may not supply pathogens to insects that might serve as mechanical carriers. Problems of sewage disposal on the farm, in the village, or in the city, of special importance in military camps. Use of cesspools, incinerators, septic tanks, sewage farms, etc. Sewage discharges into rivers or large bodies of water. Camp latrines and their care. Yard privies, their dangers and safeguards.

Keep human carriers away from insects that may serve as active carriers. People with chronic or unsuspected malaria are sources

from which the anophiles mosquito secures the pathogens of malaria in the spring. The human serves as a reservoir through the preceding winter. If all such cases were treated with anti-malarial measures there would be no reappearance of malaria from such a source. People sick with malaria, yellow fever, and other diseases carried by insects should be kept away from such insects. If the insect—mosquito, biting fly, flea, louse, etc.—has no opportunity to find a human carrier, it will not become a carrier unless there is some other animal that serves as a reservoir from which the insect may secure the pathogen. England has no malaria now (1918), but England has many anopheles mosquitoes that would carry malaria if there were any humans with the disease in England. Unless extraordinary care is taken, soldiers returning from malarial countries will reintroduce the malarial parasite into England after the Great War.

Keep animal carriers away from insects that might secure pathogens from them. It is important to destroy infected rats, ground squirrels, and other animals from which the flea secures the bacillus of bubonic plague. The jungle animals of Africa are sources from which the tsetse fly secures the trypanosome of sleeping sickness. If all such infected animals were destroyed, there would be no more sleeping sickness.

Destroy the insects that may become carriers. Kill the adult insects. Use fly-traps and fly poisons. Note the bat towers of the South for the destruction of mosquitoes. Delousing equipment for army service.

Destroy the breeding-places of insects. Dispose of human and animal excretions so they may not serve as breeding-places for insects. Important consideration in building cesspools, privies, latrines, sewers, barns, cow-yards, pig-pens, etc. Dispose of garbage, carcasses of animals and decaying organic matter in which flies may breed. Drain swamp land, dry up pools and other standing water so mosquitoes will not breed there.

Use screens on windows and doors. "A yard of screen on the window is better than a yard of crepe on the door."

XIII

ANIMALS AS CARRIERS OF PATHOGENIC ORGANISMS

A.—General Considerations

The animals that are known to have carried disease to man are: The dog, the cat, the cow, the horse, the sheep, the hog, the goat, the rat, certain fish.

We must admit the possibility of there being other animal carriers whose relation to disease is yet unknown.

The organisms which animals may carry: Pathogenic bacteria, pathogenic protozoa, filtrate viruses, higher animal parasites.

The sources from which animal carriers may secure the pathogenic organisms which they carry:

(*a*) Other animals and human beings. (1) By contact. (2) From bites of animals. (3) From excretions. Through direct contact and through contamination of food, water, droplets of saliva in the air (from sneezing, coughing, etc.), dust, articles with which the animal comes in contact. (4) Carniverous animals may become diseased through the diseased flesh which they may eat.

(*b*) From insect carriers of disease. Remember that these insects in turn have secured their burdens of pathogenic organisms from other animals or men. They may be passive carriers. They may be active carriers.

Ways in which animals may carry pathogenic organisms: (*a*) As passive carriers; pathogenic organisms may be merely mechanically adherent to the surface of the skin or in the hair, or these organisms may be present in the alimentary tract, living on its surface or in the food therein contained. (*b*) As active carriers. (1) The animal may be sick with some specific disease. It may be a carrier during the active phase of the disease. It may be a carrier while recovering. It may be a carrier for a long while after recovery. (2) It may have organisms of disease living in its tissues or on its external or internal surfaces with no evidence of resulting disease.

Ways in which animals may distribute the pathogenic organisms which they carry: (*a*) Through contact. Bodily contact with hair, skin, or other parts of the animal which carries disease organisms, or through biting. (*b*) Through excretions. These excretions may be released by way of the respiratory tract, the digestive tract, the genito-urinary tract, or open sores or infected wounds of the skin, eyes or ears. These excretions may infect such secondary carriers as droplets

in the air, dust, food and water of men and animals, articles in common use.

(*c*) By way of blood-sucking insects.

(*d*) By way of their dead bodies. (1) Insect carriers from such sources. (2) Animal carriers from such sources. (3) Commercial carriers of animal foods. Food animals may be diseased and their diseased food products put on the market. *Diseased meats.* The United States Department of Agriculture, through its Bureau of Animal Industry, between 1906 and 1912, condemned over 90,000 diseased carcasses and over 4,250,000 parts of carcasses. *Diseased milk and milk products.*

(*e*) Ptomaines.

XIV

ANIMALS AS CARRIERS OF PATHOGENS—*Continued*

B.—Specific Considerations

1. *Specific Carriers.*—(*a*) The dog may carry skin diseases, respiratory diseases, intestinal diseases, hydrophobia, diphtheria (puppies). One importance of the dog as a source of injury and as a carrier of disease is shown in the weekly bulletin of the Department of Health for New York City, February 27, 1918, which reads in part as follows:

NUMBER OF DOG BITES REPORTED AND THE CHARACTER OF THE CONTROL OF THE ANIMALS

	1915	1916	*Decrease*
Total dog bites reported	3,650	3,247	403
Dogs biting while leashed	404	358	82
Dogs biting while muzzled *	404	263	141
Dogs biting while leashed and muzzled	263	120	143
Not leashed or muzzled	2,334	2,333	1
Condition of control not known	209	163	46
Dogs biting (animals licensed)	...	1,254	..
Dogs biting (animals ownerless)	...	247	..
Vicious dogs destroyed (Sec. 10 S. C.)	...	796	..
Rabid dogs (Laboratory confirmation)	113	24	89

* Many dogs are only apparently muzzled. Recently the courts have decided that an animal which can still bite is not muzzled within the meaning of the law.

NUMBER OF DOG BITES REPORTED AND THE OCCURRENCES OF HUMAN AND ANIMAL RABIES—1907 TO 1918 INCLUSIVE

	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918
Total bites.	1,104	4,622	5,168	3,792	4,509	4,192	4,366	4,462	3,640	3,247	2,873	2,807
Cases of rabies (human)	28	16	7	7	11	6	8	8	1	1	1	0
Cases of rabies (animals, dogs)..	37	104	57	75	212	239	139	318	113	34	31	19
Deaths from rabies (human).....	28	16	7	7	11	5	8	8	1	1	0	0

(*b*) *The Cat.*—(1) As an active carrier (diphtheria). (2) As a passive carrier. The habits of the cat in the city and on the farm give that animal many opportunities to secure infectious material and to distribute it.

(*c*) *The Cow.*—Beef may contain (1) bladder-worms of tinea; (2) various diseases of cattle, foot-and-mouth disease, bovine tuberculosis; the bacteria of decomposition; and their toxic products may be communicated to man through "spoiled" beef. Milk may contain organisms of disease that exist in the cow (mastitis, bovine tuberculosis, etc.). Milk may be contaminated by the excretions from the cow, other animals, or human beings. The clean milk supplied by the Straus depots during recent summers in New York City reduced infant mortality from milk-borne diseases.

(*d*) *The Horse.*—Certain diseases of the horse are transmissible to man. Flesh eaten in some countries.

(*e*) *The Sheep.*—(Anthrax).

(*f*) *The Goat.*—(Malta fever).

(*g*) *Certain Fish.*—(Bladder-worm or tapeworm).

(*h*) *Oysters.*—(Typhoid, ptomaines).

(*i*) *The Hog.*—(Trichinæ, bladder-worms).

(*j*) *The Rat.*—Bubonic plague and the flea, dwarf tapeworm, other possibilities.

2. *Defenses Against Such Carriers.*—(*a*) Prevent the infection of animals. Improve their sanitary and hygienic surroundings. Keep human and animal excretions from reaching them. Keep carriers of disease from them, such as rabid animals, biting insects, and human carriers.

(*b*) Prevent the infection of humans by animals. (1) Destroy diseased animals or effectively isolate them until cured. Destroy rats. (2) Keep animal carriers away from humans. Danger from pets. (3) Keep animal excretions away from human food, drink, and articles in common use. (4) Inspect and condemn all diseased animal foods or animal products. Federal Meat Inspection, United States Department of

Agriculture, Bureau of Animal Industry, data for last six years, ending September 23, 1912: Animals inspected at slaughter, over 321,000,000 carcasses condemned, over 90,000; parts of carcasses condemned, over 4,250,000; reinspection of meat and meat food products in their various preparations, over 37,000,000,000 pounds; condemned on reinspection, over 140,000,000 pounds; exported under certificate, 7,000,000 pounds. (5) Institute rigid sanitary measures in establishments producing animal foods—dairies, packing-houses, meat markets, stockyards. (6) Institute and enforce intra-state inspection.

XV

THE DISSEMINATION OF PATHOGENS THROUGH CONTACT

A. The most common and the most important contact diseases are the venereal diseases. These diseases may be carried indirectly by secondary carriers, but their most common conveyance is by direct intimate contact between the human carrier and his victim. This intimate contact is secured under various circumstances, such as:

(1) *Between husband and wife.*—The numerous natural honorable and sacred intimacies that characterize the normal relationship between husband and wife make it most difficult for either one to acquire venereal disease without transferring such disease to the other.

(2) *Between parent and child.*—(*a*) The contact between the father and his children is not so intimate as the contact between the mother and her children. If, however, the father has venereal disease, the mother can hardly escape, so the children will be exposed to maternal infection as well. (*b*) The infant of a gonorrheal or syphilitic mother becomes infected either before birth or at birth. (*c*) If the mother becomes infected after the birth of her children she may transmit her disease to her children through such intimacies as nursing, feeding, kissing, bathing, or fondling them. Remember, such infection, if it is with the treponema of syphilis, frequently means death to the unborn babe or some physical or mental disability disqualifying and limiting it for life; if it is with the coccus of gonorrhea, it often means a blind baby—a life without eyes.

(3) *Between members of the same family in which one member has been infected.*—The opportunity indicated above as existing between parents and children exists also between sons and daughters, young and old. The opportunities for such intimate contact in the home are commonly present and hard to avoid, even when such avoidance be-

comes seriously necessary. It is, therefore, commonly true that syphilis and gonorrhea are transferred by contact from one infected member of the family to some or all of the remaining members of the family. This transfer of infection is inevitable between husband and wife after one of the two becomes infected and most difficult to avoid between infected parent and child, or between an infected brother or sister and the other children in the family.

(4) *Between the physician, the nurse and the infected patient.*— Many cases are on record in which the physician or nurse has become infected while operating upon or caring for a syphilitic or a gonorrheal patient.

(5) *Between the carrier of venereal disease and his victim* under any condition of intimate contact, as in (*a*) Handling, fondling, kissing, etc. (*b*) The most common and most important contact in this connection is that which occurs in illegitimate sexual intercourse. Every loose man and every loose woman sooner or later becomes a carrier of one or all of the venereal diseases. (Remember, syphilis is caused by the treponema pallidum; gonorrhea is caused by the gonococcus; and chancroid is caused by a specific bacillus.) Loose moral characters of this sort are found in all parts of the world, in every community. It is not possible to estimate accurately the number of human carriers of syphilis and gonorrhea in New York City. Probably five percent of the population has syphilis, and a very much larger percent gonorrhea.

The venereal diseases are the most common diseases of mankind excepting possibly tuberculosis. These diseases are mentally, morally and physically destructive. They are distributed by contact infection. The common and important carriers are the men and women who resort to illicit, promiscuous sexual intercourse. The man or woman that adopts such a practice must sooner or later suffer the effects of one or all of these diseases and will in all probability be responsible for conveying such disease to some other human being, who will thus become the victim—innocent or guilty—of his passion.

XVI

THE DISSEMINATION OF PATHOGENS THROUGH CONTACT—*Continued*

B. The pathogens that are excreted through the respiratory tract are distributed most frequently through contact infection. These pathogens cause such disease as measles, the common cold, diphtheria, tonsilitis, scarlet fever, mumps, meningitis, poliomyelitis, leprosy and whooping-cough. Others might be added. (2) *The "contact" necessary for infection* from such sources must be intimate. It must result in the passage of pathogenic organisms from the carrier to the "victim." This may be accomplished through fondling, kissing, biting, or scratching; from passing a pipe from one mouth to another; through chewing gum, or biting the partially eaten apple of another person; through testing the baby's milk by sucking a sample through the nipple of the baby's bottle; through chewing the baby's food before giving it to the baby; through a bite from another man's plug of tobacco; through drinking from another's cup; through breathing air into which some one has just sneezed, coughed, or otherwise sprayed his infected respiratory excretions. Opportunities for such infections are specially present in congested subway travel, movie shows, and in the life of the average infant and young child. (Droplet infection.)

C. More rare are those contact infections in which the individual picks up specific organisms of disease through handling persons who are carriers of disease (sick or well). (1) *Doctors and nurses not infrequently become infected in this manner.* Such infections are not confined to any group or class of human disease carriers. The physician or nurse may (and often do) become infected through contact with blood or tissue juices during surgical operations. They may come into intimate contact through the administration of medicine; bathing the patient; dressing a wound; or any other of the very necessary and very important offices which they perform. Contact infection under such circumstances is due to carelessness or accident. The intelligent physician and nurse know these dangers and how to avoid them. (2) The same variety of opportunities for contact infection occurs in homes in which some member of the family is sick, especially if the family habits of personal and domestic hygiene are not good.

D. Contact infection may occur in large crowds where people are brought close together, as in congested subway trains, on the ferry-

boat, in the street-car, on the elevated train, at the theatre, at the moving-picture show, in the class-room, and so on. Under such circumstances droplet infection is probably the most common variety of contact infection.

E. The diseases of the intestinal tract are usually not transferred by direct contact, although such conveyance does take place. The soiled fingers of the carrier may come into intimate contact with his victim and thus distribute to him the bacillus of typhoid fever or some other cause of intestinal disease. It is said that 4 per cent. of all typhoid fever cases that recover become chronic carriers. The majority of these are fecal carriers. The fingers of typhoid carriers or the carrier of any other disease organism are always dangerous and call for most careful hygiene. We have records of a number of men and women who have distributed typhoid fever in this manner for many years—as high as fifty-five years—after they have had that disease.

F. Summary.—Contact infection is the common mode of conveyance of the causes of venereal and respiratory diseases. It is less commonly the mode of conveyance of other diseases. Such conveyance may occur during the acute stages of these diseases, and under conditions of apparent health of the individual long after such diseases are "cured." These diseases may be avoided for the most part by such habits of personal, domestic and community hygiene as will eliminate or prevent contact infection. The individual and the community may be defended from contact infection by having no infected contacts. Personal cleanliness is a very important protective measure in relation to contact infection.

XVII

DISSEMINATION OF PATHOGENIC ORGANISMS THROUGH SECONDARY CARRIERS

Air as a Carrier of Disease

(*a*) Disease germs may be blown through the air by the wind. (1) The various human and animal excretions that are exposed to air may contain pathogenic organisms. These organisms may remain alive for hours or days or weeks, depending upon their protection from drying. If air currents set particles of these excretions in motion before the pathogens are dead these currents may serve as carriers of disease. Flakes of sputum, dejecta, urine-soaked dust, and discharges from the

sick-room may qualify for such possibilities. Fortunately such possibilities are opposed by the influence of sunlight, sun-heat and dry air, all of which destroy the lives of most pathogens, after a time. (2) Recent experiments indicate that organisms of very small size may not be subject to the ordinary laws of gravity but rather to the laws that govern gases in space. If this is true, the aerial transmission of disease germs of very small size may be much like the transmission of odors of gases in the air. (*a*) There are a number of diseases whose specific causes are so small as to be able to pass through the pores of the finest porcelain filters. They are so small that they are beyond the range of our most powerful microscopes. These "filtrate viruses" or "ultramicroscopic viruses" may be small enough to escape the laws of gravity which attract heavier bodies. They may obey the laws that govern gases in space. (*b*) There are a number of human diseases the causes of which are not known. These causes may be filterable. We have no means of testing the filtrates of some of these diseases. It is possible that the specific causes of those diseases may be small enough to fall into this class. (*c*) It is certain that aerial transmission of the sort that characterizes the movements of gases in space is not characteristic of such diseases as typhoid fever, tuberculosis, and diphtheria. The organisms that cause those diseases are relatively heavy. (*d*) We can not be certain that the causes of smallpox, infantile paralysis and scarlet fever may not be spread in this manner under exceptional and favorable circumstances.

Dust as a Carrier of Disease

Dust may be a carrier of disease only in case pathogens in dust are carried to human beings while they are still alive. Sunlight, sun-heat, dry air and other adversities kill most pathogens in minutes, hours or days. The spores of bacteria are very much more resistant than bacteria themselves. Tubercle bacilli in sputum are protected by the vicid mucous around them. Drying may then be slow. Diphtheria bacilli in membranes from the throat may remain alive for some weeks. Pathogenic organisms in fecal masses will remain alive for short periods of time. Pathogens from any source that are excreted in dark, damp, and dirty places may become parts of dust which are not thoroughly dry. They may thus escape death for short periods. The bacillus of tuberculosis, the bacillus of typhoid fever, the bacillus of diphtheria, and the streptococci of sore throat have been found in dust. Spores of various pathogenic bacteria are found in dust. Dust may be carried by the wind to human beings, to their food, or their drink. Dirty hands

and dirty utensils in common use may be infected under unusual circumstances. May explain the fact that children are more likely to have various diseases than adults.

XVIII

DISSEMINATION OF PATHOGENS THROUGH SECONDARY CARRIERS—*Continued*

Water as a Carrier of Disease

(*a*) Families that secure their water from wells are safe from water-borne diseases from that source, provided the drainage into the well is pure. It sometimes happens that the yard privy, the cesspool, or the barnyard drains into the family well. (*b*) It not uncommonly happens that communities construct water systems that draw the water supply from the same lake or river into which their community sewage is emptied. Under such circumstances typhoid fever is common. Various other diseases, notably cholera, are carried in the same way. Every community that has spent its money wisely in securing pure water has succeeded in reducing the amount of preventable sickness and the number of avoidable deaths among its citizens. This reduction is not only in typhoid fever, but in various other diseases. (*c*) Importance of pure water in active army life. (*d*) Fortunately, most of the pathogenic organisms are soon destroyed in water; unfortunately, nearly all pathogens will live for short periods in water. These short periods may be long enough to enable water-borne pathogens to find human victims.

Food as a Carrier of Disease

(*a*) Sources of disease organisms and agents in foods. The food itself may be diseased and thus act as a carrier of that disease to its human consumer. Tapeworms may come from eating raw or insufficiently cooked beef, pork, or fish infected with the cysterci of tapeworms. Cattle may have tuberculosis, anthrax, or other disease. Food may be infected while in the hands of the producer, the shipper, the transportation agent, the wholesaler, the retailer, or the consumer. Food may be adulterated by the manufacturer or dealer who uses poisonous preservatives or other injurious adulterants. Food may decompose and thus contain toxic products of bacterial action.

(*b*) Decomposed foods. The fermentation of carbohydrate foods

leads to the formation of acids, alcohol, carbon dioxide, water, etc. These end products are not so poisonous as some of the intermediate products of putrefaction. The putrefaction of nitrogenous foods, when complete, leads to the formation of simple non-poisonous compounds such as ammonia, nitrates, carbon dioxide, water, etc. The intermediate cleavage products of putrefaction are poisonous. Some of them are very poisonous. There are many kinds of fermentation and many kinds of putrefaction. "Each particular micro-organism breaks down organic matter in a specific and limited sense." (Rosenau.) Ptomaine poisoning. "Ptomaines are secondary cleavage products of protein putrefaction." The poisonous stages of decomposition of such foods as milk, cheese, and meat occur when putrefaction has not been completed. Cheese is most poisonous—if poisonous at all—when it is "green." (Rosenau.) "Meat, if toxic, is most poisonous from the fourth to the eleventh day of putrefaction." Other foods follow the same rule. The important ptomaines are sepsin, cadaverin and putrescin. " . . . Most, if not all, cases of so-called ptomaine poisoning are nothing more nor less than acute infections with B. paratyphosus, B. enteritidis, B. choleræ suis and other micro-organisms belonging to this group." (Rosenau.)

XIX

DISSEMINATION OF PATHOGENS THROUGH SECONDARY CARRIERS—*Continued*

Milk as a Carrier of Disease

"Milk is responsible for more sickness and deaths than perhaps all other foods combined, because bacteria grow well in milk; therefore, a very slight infection may produce widespread and serious results. Of all our foodstuffs, milk is the most difficult to obtain, handle, transport and deliver in a clean, fresh and satisfactory condition. It is the most readily decomposable of all our foods. Milk is the only standard article of diet obtained from animal sources consumed in its raw state." (Rosenau.)

Dirty milk. The sediment in the bottom of the milk jar or in the bottom of your glass of milk is practically always cow manure.

The organisms of certain bovine diseases will pass through the healthy udder. This is true of the ultra-microscopic virus of foot-and-mouth disease, the virus of malta fever, and the virus of milk sickness.

The organisms present in the diseased udder will likely be present in the milk. Bovine tuberculosis; mastitis.

Milk may be infected through contaminations introduced in handling, such as typhoid fever, scarlet fever, diphtheria, human tuberculosis.

"The diseases most commonly conveyed through milk are tuberculosis, typhoid fever, diphtheria, scarlet fever, septic sore throat, malta fever, foot-and-mouth disease, and milk sickness; also some of the summer complaints of children and the diarrheal and dysenteric diseases of adults. . . ." (Rosenau.)

Raw milk is not safe milk. The safest milk is the milk that is pasteurized in the bottle.

XX

DISSEMINATION OF PATHOGENS THROUGH SECONDARY CARRIERS—*Continued*

Meat as a Carrier of Disease

(*a*) Ptomaine poisoning, poisoning from spoiled meats, ptomaine produced by the bacillus botulinus, ptomaine produced by the bacillus proteus vulgaris and the bacillus coli communis.

(*b*) Infections carried by meat, sources of these infections, disease of the animal, infection of the meat after slaughter of the animal, varieties of infections carried. (1) Various forms of "meat poisoning." With bacillus enteritidis and bacillus cholera suis. (2) Paratyphoid fever. The paratyphoid bacillus multiplies in meat. (3) Trichinosis. Caused by a round worm that lives its life cycle in the hog or rat. Is communicated to man in raw and insufficiently cooked pork. (4) The pork or measly tapeworm (tœnia solium). Conveyed to man by eating raw or insufficiently cooked pork containing the bladder-worms (cysterci) of the pork tapeworm. The cysterci develop in hogs whose food has been contaminated by human feces containing the eggs of the pork tapeworm. These cysterci may develop also in man if his food contains the eggs of the pork tapeworm. This is a very serious disease. (5) The beef tapeworm (tœnia saginata). Conveyed to man by eating raw or insufficiently cooked beef containing the bladder-worm (cysterus) of the beef tapeworm.

Fish as a Carrier of Disease

Some fish are always poisonous. Some fish are poisonous only during spawning season. Fish decompose rapidly. Ptomaine poisoning is relatively common from this source. Fish are common victims of bacterial disease. Human poisoning from this source is not uncommon. Fish tapeworm (*Dibothriocephalus latus*). Human beings become in-

fected with fish tapeworm by eating fish containing the bladder-worms (*cysterci*) of fish tapeworms. Same thing occurs in dogs, cats, and foxes that eat infected fish. Fish become infected in streams polluted by human excretions containing the eggs of fish tapeworms.

Shellfish as Carriers of Disease

Ptomaines appear as secondary cleavage products of decomposition. Poisoning from shellfish is not uncommon. Typhoid fever and cholera have been carried by oysters.

Plant Foods as Carriers of Disease

Mushroom poisoning. Some species of mushrooms are edible; others are poisonous. Potato poisoning. Potatoes contain small amounts of solanin. Very rarely this poison is present in sufficient amount to cause trouble. Rice, when eaten without the bran or pericarp, may cause beri-beri, a common disease in Japan and other tropical and sub-tropical countries. A disease due to a deficiency of vitamin. Over-milled corn seems to be the cause, or a cause, of pellagra, a common and serious disease in Europe and America. Due to vitamin deficiency. Green foods, such as lettuce, radishes, celery, watercress, when eaten raw, may carry typhoid fever, cholera, dysentery, hookworm, and various other animal and vegetable parasites which have been brought to those vegetable foods in sewage or in water contaminated with sewage.

It is evident that the greater and more important part of the diseases carried by air, dust, water, or food, comes originally from human sources. These various agents are infected usually through human excretions. Our problem of self-protection here is concerned with keeping human excretions from such carriers.

SUMMARY

The human being is the most important carrier of disease. He distributes pathogens by way of his excretions—respiratory, fecal and genito-urinary—in health and in disease. His circulation may be a "reservoir" of pathogens for blood-sucking insects while he is sick or when he is apparently well.

He may transmit the organisms of disease by direct contact or through the infection of animals or insects or through the infection of articles of common use. The most important relationships are secured through "droplet infection" and spitting; illicit sexual intercourse, dirty fingers, and careless disposal of excretions.

The most important insect carriers are the fly, mosquito, flea and louse.

The most important animal carriers are the cow (by way of her milk), the rat, the dog.

The most important food carriers are milk and infected (and decomposing) meats.

Unclean, impure water is a common and dangerous carrier the world over.

The disease carrier is a serious menace in all types of communities—civic, military or institutional. Community health must be protected against persons that are sick; careless humans that "hawk" and cough and spit without regard for others; men of loose morals; prostitutes; post-febrile carriers (particularly after typhoid fever); people that practice bad hygiene; impure milk, bad water, the fly, the mosquito, the flea, the louse, the rat, the dog.

Cleanliness is the first law of health.

GENERAL HYGIENE

PART THREE

THE CONTRIBUTORY CAUSES OF POOR HEALTH

I

INTRODUCTORY

When your city, your State, or your country calls upon you for service, either in peace or in war, you young men of the College of the City of New York must be ready. At the time of the first draft of the Great War, 30 per cent. of the young men of America were found unfit for military service. Our regular army records indicated that only one applicant for enlistment out of every seven was physically fit. The figures of the Life Extension Institute indicate that 50 per cent. of the population of our country are not in sound health.

A very large part of this health deficiency is preventable and avoidable. It is a grim indictment of the health training of our nation. During the period from 1916 to 1919, thirteen States passed laws for the compulsory physical training of their future citizens. There is a powerful and growing demand that we stop wasting the lives of our citizens and conserve them for service in peace or in war.

What are you doing to conserve your vigor and to acquire a resource in health that will enable you to serve your country and yourself long and well?

Are you establishing habits of health information; habits of bodily care and repair; habits of health protection; and habits of constructive hygiene that will make of you the man you ought to be? Are you getting ready? or will you go into the discard?

Our health talks of this term are concerned with some of the influences that make it easier for you to lose your health and harder to get it back. Your policy of health control should help you protect yourself against these contributory causes of disease. You can use this information for your better training for citizenship; for your happier life; and for your greater personal success in whatever you undertake.

II

THE CONTRIBUTORY CAUSES OF DISEASE

The Contributory Causes of Disease are Those Influences That Make it Easier for Human Beings to Become Sick and Harder for Them to Get Well.

Any influence that favors the production, distribution or pathogenic activities of pathogenic organisms and their carriers may be a contributory cause of disease.

Any influence that tends to interfere with or to break down our environmental defenses against poor health and disease is a contributory cause of disease.

Any influence that tends to lessen individual human resistance to disease is a contributory cause of poor health.

Influences That Favor the Production, Distribution or Pathogenic Activity of Pathogenic Organisms and Their Carriers

The Influence of Seasons.—(1) Respiratory diseases are more common in the winter season than in the summer. This may be due to the fact that human beings are more likely to stay in the house and are therefore in closer and more intimate contact with each other during cold weather. This favors the distribution of disease germs. (2) The intestinal diseases are more common in summer. The warm temperature prolongs the life of pathogenic organisms in infected food or water. Thus pathogens that reproduce in nature multiply more profusely in warm weather than in cold weather. (3) The insect carriers of disease breed more abundantly in the summer months; for example: (*a*) Mosquito life is most favored in the warm, moist seasons of the year. Mosquitoes are known to carry various diseases, chiefly malaria and yellow fever. (*b*) Flies are produced abundantly throughout the summer. They carry the specific causes of various diseases, as typhoid fever and summer diarrhea. (4) Spring rains and spring thaws are seasonal occurrences in some countries. These seasonal freshets often wash surface accumulations into the reservoirs and other sources of water for human consumption, thus distributing disease germs to humans. Under such circumstances there are characteristic epidemics of various diseases (notably typhoid), the occurrence of which is very greatly reduced through scientific protection of the water supply. Each city that has spent its money wisely for pure drinking water has reduced the occurrence of disease among its citizens.

The Influence of Climate.—(1) Tropical and sub-tropical climates

favor the growth and vitality of many pathogenic organisms that are not commonly found in cold or temperate climates; for instance: (*a*) The hookworm is found between 36 degrees north latitude and 30 degrees south latitude in a belt that goes around the world. In this belt There are over 800,000,000 people with hookworm disease. (*b*) Tropical malaria is not commonly found in temperate climates. The parasite will grow only in warm climates. (2) Those climates that furnish warm, moist conditions offer influences under which pathogenic organisms and disease carriers are most likely either to multiply abundantly or at least to remain alive and active for longer periods of time.

Geographical Location.—(1) Rocky Mountain spotted fever (tick fever) seems to be confined to the Rocky Mountains and high plateaus of some of our Western States. This limitation of the disease may be due to the fact that the tick which carries the disease has not become infected in other localities or that it has not itself entered others. The climatic conditions present in this geographical location may then have no bearing on the occurrence of this disease. (2) The sleeping sickness which has destroyed so many human lives in Africa may be confined to that country by the same sort of influence that confines spotted fever to some of our Western States. There are biting flies in various parts of the world which could possibly carry the trypanosome of sleeping sickness quite as easily as the tsetse fly of Africa if they had the opportunity. There may be no climatic significance in the geographical location of this disease.

III

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

Influences That Favor the Production, Distribution or Pathogenic Activities of Pathogenic Organisms or Their Carriers May Be Contributory Causes of Disease.—(Continued)

Influence of Soil and Drainage.—(1) In warm climates or in warm seasons stagnant surface water becomes a breeding-place for various forms of life. (*a*) Insect carriers of disease, such as mosquitoes, flourish under such conditions. Various parts of the United States are noted for malaria simply because those localities offer excellent breeding facilities for the malarial mosquito. (*b*) If this stagnant water is infected with sewage containing pathogenic organisms those organisms are likely to remain viable for some time. Fortunately, the competition between pathogenic and non-pathogenic bacteria under such circum-

stances usually results in a victory for the non-pathogenic forms. There is danger, however, that the victory may be delayed too long. (2) Streams that flow rapidly are not such favorable breeding-places for insects as are those slowly moving, swampy streams that pass through more level country. (3) Spring freshets and spring thaws sometimes wash surface sewage into the water supply of cities. This is a common contributory cause of typhoid fever. (4) Sub-soil drainage sometimes carries sewage from cesspools and latrines into wells of drinking water. Such drainage contributes to the spread of such diseases as typhoid fever and cholera.

Influence of Weather.—(1) Lack of sunshine and excess of fog contribute to the increase of disease. The organisms of disease live longer under such circumstances. More people die in London during foggy periods than during clear periods. Such weather probably has a depressing effect on human vitality. (2) High and low temperatures are contributory causes of disease (climatic, seasonal, geographical). (*a*) Increased morbidity and mortality from intestinal diseases are common in the hot months. (*b*) Increased morbidity and mortality from respiratory diseases occur in the cold months.

IV

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

Influences That Favor the Production, Distribution or Pathogenic Activities of Pathogenic Organisms or Their Carriers May Be Contributory Causes of Disease.—(Continued)

Travel, Transportation, Immigration, Commerce and War have frequently been contributory causes of disease because they have served as agents for the dissemination of disease organisms.

The crusaders brought syphilis back to Europe on their return from the Orient. The Spaniards brought smallpox to Mexico. Cholera has been carried to Europe by the caravans from Asia, and from country to country by steamships. The rat carriers of bubonic plague have been carried by ocean vessels from port to port. The same story is true of yellow fever, malaria, measles and various other diseases.

Congestion, whether in a crowded country home or a crowded city tenement, may be a contributory cause of disease. People communicate their diseases to each other with greater ease under such conditions. Those cities that have spent their money wisely and have enforced intelligent laws for public health have been able to secure (purchase)

better health for their citizens than can be secured under ordinary circumstances in the country or in cities that have made no such wise investments. (2) Those cities that have not exercised a wise control over their congested districts have paid the penalty in disease and death.

The report of the health officer of Washington City, 1910, comparing death-rates in alley homes with death-rates in street homes, reads as follows:

Age	*Death Rate in Alleys*	*Death Rate in Streets*
All ages	30.09	17.56
Under one year	373.49	158.66
One to four years	30.82	16.75
Five to twenty years	7.84	5.25
Over twenty years	27.05	18.08

Cause of Death	*Among Whites*		*Among Negroes*	
	Alleys	*Streets*	*Alleys*	*Streets*
Pneumonia	310.9	117.9	432.8	188.1
Tuberculosis	186.5	121.2	621.3	433.7
Whooping-cough	62.2	5.3	21.9	15.5
Diarrhea, under two years of age	62.2	36.8	321.6	137.8

These contributory causes of disease must be given serious consideration in any community plan for community defense against disease. They are influences which the intelligent man must take into account in his plans for the defense of his family and himself against disease.

V

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

The Influences That Tend to Interfere with or Break Down Our Environmental Defenses Against Poor Health and Disease

War as an influence that interferes with or breaks down our environmental defense against poor health and disease. Until very recently war meant more deaths from disease than from guns and cannon. History teaches us that the armies of the past have been devastated by smallpox, syphilis, cholera, typhus, typhoid fever, malaria, and yellow fever. This is due to the fact that military tactics have been slow to include military hygiene. The army created all the favorable conditions for the spread of disease without establishing any effective defenses against disease.

In the Napoleonic wars the armies under that great general lost 400,000 men from gunfire and wounds, and 600,000 from disease. The Union Army in our Civil War lost 110,000 men from battle and 224,000

from disease. The Spanish-American War (1898) produced a mortality in the United States army of seven times as many deaths from disease as from battle. One-third of the entire American force engaged were infected by typhoid fever.

But the armies of history not only suffered enormously from disease themselves, they also carried disease to the civilian population with which they came into contact. In 1813, a war year, the death-rate in Leipzig was trebled. In Paris, in 1814, the defeated army of Napoleon brought to that city an increase in its civilian death-rate from 19,000 to 26,000, exclusive of soldiers. In 1870 Germany was almost free from smallpox. In 1871 thousands of French prisoners were taken into Germany. At that time France was overrun with smallpox. These prisoners carried the disease into Germany and between 1870 and '73 over 120,000 deaths from smallpox took place in Germany.

Within the last few years, military and marine hygiene have come to occupy places of the highest importance in the management of armies and navies. As a result our military defenses against disease are now often better than our civilian defenses. It was reported at the annual meeting of the American Public Health Association, 1917, that the occurrence of venereal disease in the regular American Army was less than in the civilian population.

The very greatest care must be taken to protect our armies and our civilian populations from the diseases that are favored and distributed by war. This care is critically important at the time of and immediately after war. Typhoid fever, typhus fever, gonorrhea, and syphilis are enemies as great and as destructive as the Hun and call for the most vigorous defensive precautions.

Commerce and business as influences that interfere with our environmental defenses against poor health and disease. The newspapers of one of our States a few years ago complained bitterly when a health officer made public the fact that bubonic plague existed in his city. They were again bitter in their complaint when a little later the State Board of Health published a bulletin showing that malaria was common in that State. Public knowledge of these facts would injure business.

The United States inspectors from the Bureau of Animal Industry condemn every year as unfit for consumption thousands of animal carcasses which were intended for the market. These officials condemn every year millions of parts of animal carcasses prepared for interstate distribution.

The Board of Health of New York City destroys thousands of quarts of milk each year, thus preventing certain milk dealers from marketing bad milk.

In these and many other ways we have evidence that business and commerce often lead men to adopt policies that are antagonistic to the public health. Such men are willing to suppress the truth at the sacrifice of human life and human health. They often deliberately attempt to circumvent laws enacted for the defense of the public against disease.

VI

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

Immigration as an Influence that Interferes with Our Environmental Defenses Against Disease and Poor Health

Stringent laws have been enacted to keep disease carriers from entering this country. It is not an easy matter to detect disease in its incipiency. Therefore disease not infrequently enters the United States by this route. (It is only fair to state that our quarantine measures are more than reasonably effective. For instance, we have had no serious epidemics from this source in years. There has been no cholera since 1873.)

The death-rate from tuberculosis in foreign-born whites is double that of native-born whites in the United States. The later type of immigrant admitted to this country up to the time of this Great War was not a healthy, rugged, resistant type which offered a good foundation for a future virile citizenship. Thus, in various ways, immigration may interfere with, break down or get through our community defenses against disease.

Carelessness as an influence that breaks down or interferes with our environmental defenses against disease. Many persons who know better spit in public places. Parents not infrequently permit their children while recovering from whooping-cough, chicken-pox, measles, scarlet fever and other communicable diseases to mingle with other children before it is safe for them to do so. Too many people are too careless about washing their hands before they eat or before they handle food intended for other people to eat.

If it is true that 4 per cent. of all people that have typhoid fever become chronic carriers of the bacilli that cause that disease there may be three or four hundred thousand typhoid carriers in continental United States. A single drop of urine from one of these cases may contain 3,000,000 typhoid bacilli. Suppose every one of 300,000 such carriers is as careless about washing his hands as you are, how safe would they be as milk dealers, bakers, butchers, grocers, waiters, cooks, dishwashers, bartenders, confectioners or cigar-makers?

It is quite as necessary to be careful with other diseases as with typhoid fever. Our best planned community defenses against disease may be easily destroyed by acts of carelessness.

Vice as an influence that destroys our environmental defenses against disease. Vice is intimately associated with poverty, bad hygiene, bad sanitation, congestion, ignorance, carelessness, alcohol, and sexual immorality.

Sexual immorality contributes to the infection of great numbers of men and women. Every human being that becomes loose in his sexual habits sooner or later has gonorrhea, or syphilis, or both. The victims of these diseases are often more easily susceptible to other diseases.

The alcoholic is more easily susceptible to disease and recovers with more difficulty from disease. These unfortunates are often wrecked mentally, morally and physically. They fill our prisons, hospitals, asylums and graveyards. They do the least amount of harm in the graveyard.

Vice is a subtle influence within a community, destroying community as well as personal defenses against diseases.

VII

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

Ignorance as an Influence that Destroys Our Environmental Defenses Against Disease

There is much that we do not know about disease but some of us are less ignorant than others. There are people that know nothing about the living things that cause disease, nothing about the carriers of disease, and nothing about our defenses against disease. Such people when they live together in communities are helpless when epidemics of disease come to them. In India, in the last twenty years, over 7,500,000 people have died of bubonic plague. When bubonic plague is attacked in India for a few years by a native population that knows how to defend itself against that disease there will be very little bubonic plague left. Havana was the home of yellow fever and malaria until men who knew how cleaned up the breeding-places of mosquitoes. The Panama Canal was impossible until men who knew how destroyed the breeding-places of the malarial and yellow fever mosquitoes.

There are people who believe that gonorrhea is no worse than a bad cold. They often pay for their ignorance with sterility, with loss

of eyesight, or with stiff, useless joints. Whenever human beings, through ignorance and carelessness, trifle with communicable disease they must pay the penalty. That penalty is often severe.

Individuals who are ignorant are more likely to expose themselves to disease. They pay the penalty for their misfortune—and those who are about them help pay the penalty.

The combination of ignorance, superstition, prejudice and fanaticism produces influences that contribute to the overthrow of our defenses against disease and to the obstruction of wise plans for the improvement of our defenses against disease.

Vaccination against smallpox has saved millions of human lives. There are numerous persons who are opposed to vaccination.

Ignorance and misunderstanding have led a number of people to oppose experimentation on animals. This opposition is based apparently on a mistaken assumption of wanton cruelty in such experimentation. Animal experimentation has taught us our most valuable lessons on the causes of, treatment of, and defenses against disease. Animal experimentation in the hands of competent investigators is carried on with no cruelty and no unnecessary pain. The treatment of animals in preparation for the market is infinitely worse than the treatment of animals used for the purpose of saving human beings from disease. The modern scientific laboratory and the modern scientific investigator are agents working in the interest of humanity.

Ignorance and certain religious enthusiasm sometimes produce strong oppositions to sane policies of public defense against disease. People in this group are commonly opposed to vaccination, animal experimentation, quarantine, medical treatment of disease, national health supervision, medical inspection in schools, and so on.

VIII

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

Low Medical Standards are Influences that Tend to Destroy Our Environmental Defenses Against Disease and Poor Health

Our requirements for admission to and graduation from medical schools have been too low. There have been and still are too many poorly trained physicians practicing on the public. Medical practice should be in the hands of well trained men and women of the very highest character. Good character is as much a requisite in the practice of medicine as good training.

Some states have enacted laws which permit inadequately trained

men and women to take responsible control over human life. Standards of admission to medical practice are low in some States. Various non-medical practitioners are admitted to license in some States.

Every precaution should be taken to guarantee that only wisely and efficiently trained medical practitioners are given responsibility in the treatment of disease. Only men and women of good character and good scientific equipment should serve on our boards of health or otherwise direct our public health activities.

Politics sometimes operate to weaken and often destroy our defenses against disease.

There should be no politics in municipal, State or national health boards.

There should be no politics in municipal, State or national hospitals.

There should be no politics in the formation of our local or State or national laws regulating the public health. All influences that tend to disorganize, suspend or evade provisions and laws for the acquisition and maintainance of public health may be, and often are, contributory causes of disease. It is a matter of most serious importance for us to encourage in every way the development of a sane and scientific policy of personal and public health control so that every citizen may understand the fundamental principles involved and every health official may be wise and effective in the discharge of his duties.

IX

THE CONTRIBUTORY CAUSES OF DISEASE—*Continued*

The Contributory Causes of Disease Include Those Influences which Tend to Lessen Human Resistance to Disease

Human resistance to disease depends upon the healthy condition of the tissue cells of which the human body is formed. Any influence that interferes with the nourishment of the tissue cells, any influence that interferes with the removal of waste products (secretions or excretions) from the tissue cells, and any influence that interferes with the work (functional activities) of the tissue cells is an influence that lowers the vitality of the cells, weakens them and makes them unhealthy and less resistant to disease. In other words, the health of the tissue cell depends upon habits of nourishment, excretion, exercise, protection, recreation and rest. Without such wise physiological habits, health is impossible.

The influence of certain normal conditions of the human body which favor disease.

Age.—Infants are more liable than adults to the following diseases: Whooping-cough, measles, chicken-pox, meningitis, infantile paralysis, broncho-pneumonia, diphtheria, scarlet fever and mumps.

Typhoid fever and tuberculosis are diseases of young adult life. The average age at death from tuberculosis is about thirty-six years.

The diseases of old age are lobar pneumonia, Bright's disease, arterio-sclerosis, heart disease and cancer.

Sex.—Women are more liable to nervous diseases such as hysteria, neurasthenia and cancer. There are certain diseases that occur only in women.

Men are more commonly affected than women with diseases that are favored by occupational influences, exposure, alcoholism, sexual excesses and other forms of dissipation.

Heredity.—Tendencies to nervous and mental disease may be inherited. The children of tubercular parents are more susceptible to tuberculosis than are children of healthy parents. The children of sickly, unhealthy parents are liable to be sickly and non-resistant to disease. War tends to eliminate the healthy, sound stock and leave the weak and poorer heredities for perpetuation and emphasis. Alcohol and syphilis are our most important factors in establishing heritable degenerations. Certain occupations tend to produce degeneracies that damage offspring. Occupations involving the use of lead and nitrate of mercury are the most dangerous from this point of view. Moot questions in heredity.

X

CERTAIN ABNORMAL PHYSICAL CONDITIONS THAT MAY ACT AS CONTRIBUTORY CAUSES OF DISEASE

Defective Vision (uncorrected).—Often accompanied by headaches and nervousness. Favors indigestion, epilepsy, and other diseases of nervous origin. Poor health and reduced resistance to disease are not infrequently consequent on the nervous irritation of uncorrected defects of vision.

Obstructed Breathing.—Caused by adenoids, tonsils, deformities of the nose and growths in the nasal passages. Leads to mouth breathing. Nasal breathing is natural breathing. When the air passes through the nose it is moistened, warmed and filtered. When the air is breathed through the mouth it cools the lining of the throat and upper air passages, dries those passages and deposits particles of dust and other foreign matter on their surfaces, and leads therefore to chronic inflamma-

tion of the nasal passages and the throat. Acute infections are favored. Because of connecting canals and passages, disease of the nose and throat often extends to the ear, the eye, the spaces in the bones of the cheek, forehead, and head, and, more rarely, to the brain. Bronchitis, pneumonia and tuberculosis are more commonly associated with chronic troubles of the nose and throat. Tonsilitis, rheumatism and heart disease are related to the evil results of obstructed breathing.

Decayed Teeth and Sore Gums.—Dirty teeth, teeth with green stain on them, teeth with tartar on them sooner or later decay. Mouths that are not clean, teeth that are not clean, are often accompanied by sore gums. Decayed teeth are often tender and thus interfere with proper chewing. If the teeth are very bad—or lost—chewing may be impossible. Chewing is essential to good digestion. Decayed teeth are "sore places" in the mouth. Disease organisms may enter the tissues through decayed teeth. Diseases of the jaw, the face, the throat, and the whole body may come from this avenue of entry. Sore gums are sometimes caused by a minute animal—an ameba. They are also avenues through which other organisms may enter the tissues. People with bad teeth, sore gums and dirty mouths get sick more easily and recover with more difficulty than people with good teeth and clean mouths.

Chronic Disease of the Middle Ear (a "Running Ear").—Cause: Usually communicated from disease of the nose and throat (see above).

Effects on Health.—May suddenly grow worse. May extend to the bones of the head (mastoiditis), great veins, large arteries, or brain, all of which are close to the ear. May lead to loss of hearing. Chronic disease of the middle ear may then, in various ways, lead to poor health and general low resistance to disease.

XI

CERTAIN ABNORMAL PHYSICAL CONDITIONS—*Continued*

A Defective Heart.—A weak heart is not necessarily a very serious matter. Persons thus affected must exercise their hearts intelligently and within certain wise limitations. Too little exercise for a defective heart may be as undesirable as too much exercise. Too little exercise weakens the heart so that it can not send nourishing blood to the tissue cells—it can not do its regular work. Too much exercise may wear such a heart out or cause serious injury from sudden strain.

A weak heart unwisely used is a source of poor health. It may be unable to force enough blood to the tissue cells. This means a lack

of oxygen and other food for those cells; they will not be well nourished and can not, therefore, be in good health. It may not be able to support the additional work thrown on it when sickness occurs. All fevers, all infections, throw work on the heart.

Chronic Indigestion.—Leads to under-nourishment and consequent general lack of resistance.

Genito-urinary Defects and Abnormalities in the male and female contribute in various ways to poor health and to local and general disease. Often a source of nervous troubles of various kinds.

Infectious Diseases Common Here.—Venereal diseases contribute very largely to poor mental and nervous health, poor physical health, poor heredity.

Other abnormal conditions that contribute to poor health are:

Curvature of the Spine.—Functional variety usually of no consequence.

Flat Chest.—Often associated with spinal curvature. May accompany poor lungs. Frequently of no significance.

Flat Feet and Weak Feet.—May have no effect on general health. May not be noticed and may cause no discomfort. May cause great inconvenience, pain and disability, with a general nervous irritability—all of which means poor health. Flat feet and weak feet are sources of very serious military disability. Spinal curvature, flat chest and weak feet may all be parts of a generally weak musculature, and accompany poor nourishment and debility.

Obesity usually means poor resistance. Mortality and morbidity are high in obese persons.

Emaciation is usually the effect of acute or chronic disease and is an evidence of lowered vitality. The common consequence of tuberculosis, Bright's disease, indigestion and malignant growth.

XII

CERTAIN ABNORMAL PHYSICAL CONDITIONS—*Continued*

Chronic Local Inflammations and Irritations.—May serve as avenues for infection. May develop into cancer, *e.g.,* irritated, bleeding warts, moles, scars and ulcers.

Chronic Disease.—May interfere with general nutrition, excretion, exercise or rest and thus cause poor health. Long continued disease leads to diminished resistance. It is said that men rarely die of chronic disease. They usually die because of some acute infection which these chronic diseases have made them unable to withstand. Among these

chronic diseases are tuberculosis, hookworm disease, syphilis, gonorrhea, alcoholism, lead poisoning, Bright's disease, tapeworm disease, heart disease, chronic indigestion, chronic middle ear infection, chronic disease of the nose and throat, chronic bone disease, and so on.

The After-effects of Acute Disease.—Acute diseases not infrequently take so much strength and vitality from their victims that they easily succumb to later attacks of the same or other acute diseases. Acute diseases sometimes leave permanent damage behind which make the patient less resistant to other diseases. Scarlet fever often leaves weak kidneys. Diphtheria, rheumatism, tonsilitis, scarlet fever and other acute febrile diseases often damage the heart. Pneumonia, whooping-cough and measles often leave the lungs "weak" and prone to tuberculosis. There are numerous other examples of such effects of acute disease.

Gonorrhea may destroy vision, ruin the joints and produce sterility. Syphilis may cause paralysis, mental deterioration and sterility. It may establish a heritage of germ cell damage which shows itself later in various nervous diseases, idiocy, imbecility and insanity of descendants.

Traumatic Injuries.—Gross injuries to the skin, bones or other organs may open avenues of infection, destroy the organs concerned or leave the patient an invalid.

Minute injuries may be caused by inorganic dust or irritating vapors, gases, and chemicals. These injuries are characteristic occupational influences. Men who work in metal often are forced to breathe air that contains minute particles of metal which lacerate the eyeballs or the lining of the air passages. Lung diseases are common among men in such occupations.

These various abnormal conditions interfere with the nourishment of tissue cells, or the functional activities or the removal of excretions or with the rest of tissue cells. They subject them to communicable disease either because they open avenues of tissue infection or because they weaken those tissues and make them less resistant to disease, or more liable to permanent deterioration.

XIII

INTERFERENCES WITH NOURISHMENT

Any influence that interferes with the physiology of the tissue cell will injure the cell and may be the source of poor health of the cell and therefore to the human being of whom that cell is a living part.

The physiology of the tissue cell, broadly speaking, is made up of its nourishment, excretion, exercise (function) and rest.

Influences that Interfere with Nourishment.—(*a*) *Community influences:* Anything that interferes with the food supply; war; famine; inadequate transportation or inefficient distribution from any cause; poverty.

(*b*) *Domestic or Family Influences:* Anything that interferes with the family supply; poverty; bad economic habits (alcoholism); poor quality of food. Food with low fuel values are poor foods. Foods with high fuel values are good foods assuming that they are digestible. Unwise selection of food for family use. Poor cooking. Good food may become poor food if the cooking is poor. The cooking may be insufficient and thus leave the food tough and hard to chew or fail to destroy the organisms that may have infected the food, or fail to make the food palatable and attractive. Poor cooking may therefore lead to poor health. Unattractive table service. An unappetizing and unattractive preparation and service of food fails to stimulate either appetite or digestion. Distasteful food is digested with difficulty. A meal eaten in unpleasant surroundings is not easily digested. Standards vary. Food that is attractive to one family may not be attractive to another. Surroundings that please one household may be unpleasant to another. Don't be in a hurry to impose your standards of attraction and pleasure on others. Unattractive food and unattractive service are factors in the production of indigestion and poor health to those persons to whom such service is unpleasant. Ventilation as a family problem of "food supply" (oxygen). The air we breathe contains oxygen which is taken up by the blood in the walls of the lungs and carried to the tissue cells. This food (oxygen) is requisite to the life of the tissue cell; without it they die. The results of recent experiments seem to show that ordinary air contains enough oxygen to serve our respiratory needs after many repeated passages through the lungs. The disagreeable effects of poor ventilation appear to be due to odors, humidity, high temperature and lack of motion in the air. A dry, hot air with odor and no motion may also be distressing. On the other hand, it is common experience that people who habitually breathe fresh air, particularly out-of-door air, are in better physical condition than people who habitually breathe "old" air or much used indoor air.

XIV

INTERFERENCES WITH NOURISHMENT—*Continued*

Habits of the Individual that Interfere with the Nourishment of His Tissue Cells

Meals that are eaten under unpleasant emotional excitement (anger, fear, apprehension and the stress of hurry) are not easily digested. Under such nervous influences secretion of digestive juices stops. Under such nervous influences the digestive movements of the intestinal canal stop.

Meals that are eaten in distinctly unpleasant surroundings, meals that are not attractive, food that is distasteful, are all sources of indigestion. Under such unpleasant influences the digestive secretions and movements stop.

Rapid eating and insufficient mastication may lead to indigestion. Starchy foods when well mixed with saliva (from the mouth) will undergo partial digestion while they are stored in the upper part of the stomach after the meal. If such food is not well chewed, this opportunity for digestion is lost and more work is required farther on in the canal. Food that is swallowed in chunks is digested more slowly. Those chunks may in the course of time cause ulceration of the stomach, with the possibility later of malignant growth.

Overeating may lead to indigestion and lead to undernourishment.

Indigestible food may cause dyspepsia and lead to poor nutrition. Food that is indigestible for one person may be digestible for another. As a rule corned beef and cabbage are hard to digest. Fried food and greasy food is usually slow to digest. The powers of digestion vary with age and condition. The problems of nourishment for babies, children, adults and old people differ. The powers of digestion vary with the different individuals and with the same individuals at different times.

Some foods are not as nourishing as others. Charts showing food values may be easily found. The tissues need nourishment made up from protein food, such as meat, eggs and milk. Fatty food such as butter and the fat in meats. Carbohydrate food such as cereals, vegetables and bread. Certain salts and water found in all foods and in all potable water. Few of us drink enough water.

Unpleasant excitement, unhappy emotions, vigorous exercise and great hurry are bad influences when they occur immediately before meals or immediately after meals.

Problem of poor respiratory habits and "oxygen starvation" of the tissue cells; the bad effects of chronically poor ventilation of the lungs may be due to lack of oxygen.

XV

INTERFERENCES WITH NOURISHMENT—*Continued*

Bad habits of rest may interfere with nourishment. We regard rest as a condition requisite for adequate tissue nourishment. Relative rest is a term we apply to simple inactivity. The processes of cell nourishment go on during relative rest, but not adequately. Absolute rest is secured only by sleep. Absolute rest is requisite for effective tissue nourishment. During periods of rest the tissue cells use food that is brought them in solution by the blood. This food is secured by the blood from the intestinal tract and the lungs. The intestinal tract furnishes dissolved proteins, fatty and carbohydrate food, the various salts and water. The lungs furnish oxygen. From this food the tissue cell builds up its own structure. The muscle cell makes muscle. The nerve cell makes nerve. The bone cell makes bone. Each cell builds its own structure. From this food the tissue cell manufactures the chemical substances with which it does its regular work. The muscle cell manufactures a something which makes it contract. The nerve cell manufactures a something with which it is enabled to send or receive nervous impulses. The brain cell uses its food for the manufacture of a something out of which thoughts are made, or with which the will commands an act.

We move, we see, we feel, we think, with the food we eat. Your bread and butter to-day will be your thoughts and acts to-morrow.

Any influence that interferes with adequate rest, interferes with tissue nourishment and may eventually become a cause of poor health.

XVI

INTERFERENCES WITH EXCRETION

The excretions from the tissue cells escape by way of (*a*) the respiratory tract, (*b*) the genito-urinary tract, (*c*) the skin, (*d*) the bowels. The discharges from the bowels are largely wastes that have simply passed through the alimentary canal. Such wastes are not tissue excretions.

Interferences with the escape of excretions by the way of respiratory

tract. Carbon dioxide is the chief respiratory excretion. Chief interferences occur in disease of the heart and lungs. Question as to the effect of a considerable increase in the carbon dioxide content of the inspired air. Older theories assumed that carbon dioxide was poison. More recent experiments show that carbon dioxide is much less injurious than was then thought. Possibility that an increase in the amount of carbon dioxide in the blood for long periods of time may have an injurious effect. The ventilation of the lungs is a problem of room ventilation and a problem of right breathing. Influences of sedentary life on respiratory excretion and the influence of exercise as a respiratory stimulant.

Interferences with the escape of excretions by way of the genito-urinary tract. The excretions eliminated through the kidneys are complex. They come from all the tissue cells. They are contained in the urine. Kidney disease may interfere with adequate excretion. The habit of drinking too little water may limit the efficiency of the kidney excretion. Sedentary life and overeating burden the kidneys. Excessive exercises throw work on the kidneys. Good health is not possible if the kidneys are not in good condition.

Interference with the escape of the excretions by way of the skin. Various glands in the skin assist in the removal of excretions from the blood. A dirty skin is not likely to be an active skin. A sedentary, inactive life makes too little demand on the skin.

Interference with excretions and wastes by way of the bowels. The discharges from the bowels are in large part material which has been rejected in the digestive tract. Constipation and sluggish intestinal action from any cause is injurious.

The most important interferences with these excretions may occur as follows: (*a*) A sedentary, inactive life is accompanied by sluggish respiration, inactive skin and inadequate discharges from the bowels. (*b*) Overeating and under-exercise throw too much work on the kidneys. (*c*) Excessive exercise burdens the kidneys. (*d*) If one drinks too little water he will have an acid, irritating urine which, in the course of time, may injure the kidneys. (*e*) Constipation from any cause is undesirable. One should have at least one full movement of the bowels every day.

Any of the above "interferences" may lead to poor health and thus become contributory causes of disease.

The excretions of the tissue cells are cast out of the cells into the blood and carried by the blood to the lungs, the kidneys, the skin, or other excretory organs through which they are eliminated from the body. Excretion from the tissue cells is accomplished during periods

of rest. The wastes accumulate during activity and are removed during periods of rest. It is therefore probably true that rest and sleep are useful for tissue excretion as well as for tissue nourishment.

XVII

INFLUENCES THAT INTERFERE WITH THE EXERCISE (FUNCTION) OF THE TISSUE CELL

Lack of Physical Exercise.—A sedentary life interferes with the normal activities of most of the tissue cells. The muscles are inactive. The nerves that send messages to and from the muscles are inactive. The joints are inactive. The heart and blood vessels are relatively inactive. The lungs do a minimum amount of respiratory work. Aside from those of the brain and certain special organs, all the tissue cells are more sluggish in the human being that leads an inactive, sedentary life.

The effect of the inactivity of these very numerous tissue cells is shown in weak muscles, poor circulation, sluggish excretions, excess of fat and general debility. These conditions are factors in the production of early old age, tissue degeneration, and poor health. General poor health from such causes is now greatly on the increase in this country. An apparent increase of 41 per cent. in the death-rate due to degeneration diseases during the last twenty years. We have about 410,000 deaths annually in the United States from organic diseases of the kidneys and urinary system, and of the heart and circulatory system, including apoplexy and paralysis. (Life Extension Institute, February 2, 1915.)

Influences of Too Much Physical Exercise.—Muscles that are given heavy, unusual exercise without gradual training become tender and painful. The effects may be temporarily incapacitating. A well-muscled man returning to physical exercise after a period of inactivity may break bones or tendons weakened by disuse. Excessive exercise may cause various asymmetries, enlargement of the heart, dilation of the heart, and rupture. Persons having weak organs need exercise as much as persons with normal organs, but they must exercise with more care. This is particularly true in disease and weakness of the heart, arteries, lungs, hernia (rupture), kidney disease, and chronic abdominal diseases (appendicitis). Physical exercise should be avoided in the presence of acute disease, particularly if accompanied by fever. Persons with stiff joints or paralyzed muscles simply have a greater difficulty finding exercise they can do.

A wise and intelligent daily habit of exercise will go a long way toward securing health. Regular habits of exercise are essential to the best of health interest of the weak and strong. Special habits of exercise are necessary for individuals limited by organic weakness or disability.

XVIII

INFLUENCES THAT INTERFERE WITH THE EXERCISE (*i.e,* FUNCTION) OF THE TISSUE CELL—*Continued*

Interference with the Function of the Nerve Cell

Disuse.—Nerve cells that are not used do not develop. They atrophy. (This is true of all cells.) Eyes that have never been used are blind. The child born deaf may never talk. The nerve cells that control his speech are not exercised. When muscles are destroyed the nerve cells that supply them degenerate. If a considerable nerve area is "weakened" by disuse the individual suffers a general debility. This is a condition characteristic of sedentary life. A nerve like any other cell when "weakened" by disuse contributes to the general weakening and non-resistance of the whole body.

Overuse.—Overuse of the nerve cell produces fatigue of the nerve cell. It is then unable, temporarily at least, to perform its normal function in a normal way. More or less serious disturbances may follow. The nerve cell that is given regular, reasonable exercise becomes a healthy nerve cell and performs its normal functions efficiently. Such a nerve cell is an "educated" nerve cell.

Causes of Mental and Nervous Disturbances (after August Forel)

Inheritance.—Damage of the germ cell not uncommonly shows its effect in a damage of the nerve cells of descendants revealed through imbecility, idiocy, and other exhibitions of mental degeneracy.

General Predisposing Elements in the Life of the Individual

Age—Childhood.—Predisposed to epilepsy, hysteria and hypochondria. A period when inherited tendencies may be emphasized by bad mental hygiene in the home or in the school.

Vigorous Middle Life.—This is the period of life in which mental and nervous diseases are more commonly "acquired" rather than exhibited as inherited diseases. It is a time when bad social hygiene, bad

community hygiene, or bad industrial hygiene is brought to bear on the mental and nervous status of the vigorous, active human being.

Advanced Age.—There is a shrinking of the brain which accompanies age, accompanied by a tendency to mental deterioration and perversion.

Sex.—The common predisposing causes of mental and nervous disease that are due to sex are peculiar to women. These causes are associated with childbirth, the climacteric, menstruation and with the period of pregnancy.

Acquired Causes of Injury to the Nerve Cell

(*a*) *Purely Bodily or Material Causes.*—All poisonings, especially alcohol. Infections, especially syphilis. Metabolic diseases, *e.g.*, gout, disease of the thyroid gland. Abnormal modes of life. Bad habits of personal and domestic hygiene, associated with poor nervous heredity. All direct wounds and local organic diseases of the brain.

(*b*) *Purely Psychic or Mental Causes* (nothing is really purely mental).—Suggestion, auto-suggestion, psychic contagion, strong emotions often repeated.

(*c*) *Mixed Psychic Causes.*—Disturbances of sleep. Exaggerated sexual life. Continued purely mental excitement and the dominance of sexual images which finally fill the person completely.

General consideration of the causes of mental and nervous disease. Tremendously complicated. Rarely act alone. Hereditary tendency the main cause. Alcohol the chief cause of injury to the germ plasma, and therefore the most important cause of bad heredity. Other sources of injury to the germ plasma are noted above. Unhealthy conditions of life and of emotions are next in importance. General tremendous increase in mental and nervous disease in most civilized countries. The mental and nervous degenerate of modern times is permitted to procreate. The strong and healthy are led to war. The world was becoming alcoholized. The world has been syphilized. The modern emotional pace is too excessive and too intense.

The phenomena of "shell shock" in the Great War are due very largely to the extraordinary and intensely powerful emotional influences that come into the lives of the soldiers. The same influences that lead to nervous disease in civilian life operate in military life. They are, however, more concentrated, more immediate, and more dramatic than in civil life.

XIX

INTERFERENCES WITH THE HEAT REGULATING CELLS OF THE BODY (VASOMOTOR SYSTEM)

Warm-blooded animals are able to maintain a fairly even temperature (98.8 degrees F. by mouth) in spite of changes in the temperature of their surroundings. Cold-blooded animals take on the temperature of their surroundings. The human animal helps his heat regulating mechanisms by heating his home in the winter, opening windows in the summer, wearing clothes of different warmths at different seasons, regulating the ventilation of living and working quarters.

The heat regulating mechanism may be interfered with to the health injury of the individual by

Drafts.—A draft of air of cold temperature is not in itself a cause of disease. It is an influence which contributes to the ease of infection through its effect on the heat regulation of persons of poor resistance.

Exposure to Wet and Cold.—Affect the activity of the vasomotor system in the same way that drafts do; a common contributory cause of respiratory infection. Produces a local increase in the secretions of the nose and throat—a good culture medium for some bacteria. May have an injurious effect on the white blood corpuscles and other blood defenses against disease when those defensive factors pass through the cooled skin. Wet and cold not infrequently contribute to the respiratory infection of infants, the aged, and persons in poor physical condition.

Poor Ventilation.—System of ventilation to be effective must produce air in gentle motion; the breeze of an electric fan; supply air of comfortable temperature, between 65 and 68 degrees Fahrenheit; supply air with a relative humidity between 50 and 70 per cent.; supply clean air, free from dust, odors, and gases. When ventilation is not efficient, dry, stagnant, hot, bad-smelling air is too often the result. A factor in poor health.

Insufficient Heat.—The room temperature should be between 65 and 68 degrees Fahrenheit. The surface temperature of the body should be maintained out of doors by adequate clothing. Further discussion as above.

Overheating of Living or Working Rooms.—Increase susceptibility to drafts and cold. Particularly undesirable if the occupant is dressed too warmly.

SUMMARY

In these health talks we have discussed (1) some of the influences that favor the production, distribution or pathogenic activities of pathogenic organisms and their carriers; (2) some of the influences that tend to interfere with or break down our environmental defenses of health; and (3) some of the influences that lessen human resistance to disease.

This information may be of practical use to you in the formation of your habits of health protection as an individual and as a voting citizen. It may serve you at home, in peaceful occupation, or in war. The principles covered and the facts stated are applicable to all conditions of life. But this information, these principles and these facts are of no value and can be of no value to you unless you make them a part of your own equipment and use them in your own life.

It is the hope of the Department that you have established enduring habits of informational hygiene that will lead you to consult good health literature and to consult regularly safe health examiners and advisors; that you have made it your habit to care for your body and all of its organs; that you have acquired permanent habits of protection against the agents that injure health, the pathogen carriers, and the contributory causes of disease; and that you are constantly using wise habits of constructive hygiene in your habits of nourishment, your habits of excretion, work, exercise and play, and your habits of rest.

If you have established such habits you will be better able to play your part in the world; you will live longer; you will serve yourself, your family, and your country more productively, more usefully, and more vigorously. When your call to citizen service comes you will be ready.

GENERAL HYGIENE

PART FOUR

THE DEFENSES OF HEALTH

I

INTRODUCTORY

Health is on the market. It can be bought. The man or the community that is willing and able to pay the price may buy. New Orleans has purchased freedom from yellow fever. Money invested in Havana has bought relief from malaria and yellow fever. The United States paid money for health in the Panama Canal Zone and got what it paid for. New York City has bought the lowest municipal death-rate in the world through investments made in its Health Department, in its pure water supplies, in its Department of Sewers, in its Tenement House Department, Street Cleaning Department, parks and park control, and so on. The United States spent money on the prevention of venereal disease in the army during the Great War and reduced the occurrency of gonorrhea, syphilis, and chancroid to one-third its pre-war percentage.

Whenever a man, a family, a village, a city, or a nation has spent money wisely the purchase has secured a quality and an amount of health improvement that has been worth infinitely more than the monetary cost.

But there is a point, a limit beyond which the dollar can not go. Money will buy clean water. It will destroy the breeding-places of mosquitoes and flies and other pathogen carriers. It will dispose of sewage. But it can not buy habits of individual hygiene. It can not make humans inform themselves wisely concerning the laws of general hygiene, individual hygiene, and group hygiene, or secure for themselves regular health examinations and advice from competent, honorable health experts. It can not make them take care of their bodies or avoid intelligently the agents that injure health or the agents that carry pathogens. It can not make humans eat wisely, excrete regularly, work physiologically, recreate and play cheerfully and joyously, and sleep adequately. Money can not buy individual health habits.

Health in these modern times is a product of community habits and of individual habits of hygiene. The health achievement of either is limited in the absence or failure of the other. A working combination of the two must lead to the lowest morbidity and mortality rates yet secured. We have made one of the greatest advances in recent years along lines of community hygiene. Individual hygiene has lagged.

Upon you, college men, citizens of the future, depends more than on any one else the health defenses of the future. The health habits you are acquiring now will govern you and influence your community then. As you defend your own vigor, and your own physiological resources, so will you defend the health and the vigor of your city and your State. What are you doing? Are you wasting these years?

II

OUR NATURAL DEFENSES AGAINST DISEASE

Our steadily increasing knowledge of the causes and the carriers of disease has furnished us with some information concerning various natural agents whose normal operations tend to protect us from disease. These agents have acted for the conservation of human life unaffected by our ignorance through all the ages during which there has been human life and during which there have been disease-causing enemies of human life. Those natural defenses against disease exist in our environment or in the surface defenses of the human body or in the physiological activities of the bodily tissues. Modern hygiene has amassed information concerning the influences that damage and destroy health; has accumulated facts relating to those natural agents that destroy or interfere with the causes and carriers of disease; and from these sources modern hygiene is organizing rational scientific systems of personal, domestic, institutional, industrial, community and intercommunity hygiene and sanitation for the conservation of human life.

We have then a growing knowledge of the natural agents that protect us from disease and we are more and more commonly utilizing, directing and co-ordinating those agents for the more effective defense of human life.

Natural Defenses Against Disease

Environment Defenses: Sunlight, sun heat, high and low temperature, lack of moisture, fresh, clean air, lack of factors requisite to the vitality of animal and vegetable causes and carriers of disease.

Surface Defenses of the Human Body: External surface—skin, internal surface—mucous membranes, surface secretions, the cilia.

Internal Defenses of the Human Body: Normal healthy tissue cells, phagocytosis, lysis, formation of antibodies, immunity reactions, inflammatory reactions.

Utilization of These Defenses Through Wise Systems of Individual and Group Hygiene

(*a*) Personal or individual hygiene.
(*b*) Domestic hygiene.
(*c*) Community hygiene.
(*d*) Rural hygiene.
(*e*) School hygiene.
(*f*) Institutional hygiene.
(*g*) Military hygiene.
(*h*) Industrial hygiene.
(*i*) Inter-community hygiene.

III

OUR NATURAL DEFENSES AGAINST DISEASE—*Continued*

The various organisms that cause disease and the various agents that carry disease are present all about us. Man in health and in disease expels myriads of pathogens by way of his respiratory, fecal, genito-urinary and other excretions and discharges. One human being sick with tuberculosis may expectorate billions of tubercle bacilli in a single day, enough, if evenly distributed, to infect the entire human race. There are always, approximately, 3,000,000 persons sick with some disease or other in the United States and each one is more or less constantly discharging his many billions of pathogens.

Every one of those pathogenic organisms, under favorable conditions, is capable of enormous increase in numbers. A single bacterium, if left alone, if not restricted in its natural tendency to multiply by simple division, would within a few days produce enough bacteria to equal the bulk of the earth. A single tapeworm may produce 150,000,000 eggs in a year. Evidently there are some very effective reasons why these many varieties of disease-causing organisms have not destroyed the human race and covered the universe. Those reasons constitute our natural external defenses against disease.

Our Natural External Defenses Against Disease

Sunlight.—Destroys most pathogenic organisms rapidly. The ultraviolet rays are the destructive agents. The bacillus of tuberculosis present in sputum may live in sunlight for twenty hours or more. The amount of time it takes sunlight to destroy bacteria varies under different conditions. The important point for us to remember is that this bactericidal action of sunlight takes time. Furthermore, the spores of some bacteria resist sunlight for a long time. The spores of the bacillus of anthrax are said to have been found capable of growth after exposure for thirty years in the surface soil of a pasture.

Drying is another influence that destroys most pathogens rapidly. The bacteria that cause boils and abscesses are fairly resistant. The cause of infantile paralysis is resistant. Tubercle bacilli in sputum and diphtheria bacilli in membrane expelled from the throat may live for a long time. The larvæ of the hookworm will live for weeks in moist, warm grass, green vegetables or soil, but they die very quickly if their surroundings are dry.

Low temperatures are not favorable to pathogenic growth and freezing destroys most but not all such organisms. The bacilli of typhoid fever have been recovered from ice.

High temperature destroys all pathogens, even spores, but the temperatures in nature are never high enough to accomplish this result effectively. We use heat as a germicide. In nature, the combination of sunlight, sun heat and fresh air is destructive to pathogens, and in time to most of their spores.

Lack of Favorable Environment.—The life of bacteria and other pathogens depends upon darkness, moisture, warmth and food. The heat and light of the sun are continually making conditions unfavorable for such life. In addition, other factors which we do not understand are at work making it impossible for most pathogens to live long or reproduce themselves outside the human body. There are a few, however, that do live in nature, either in adult form or larvæ form or as spores, and there are some that reproduce in nature and multiply, but in every case nature must supply a particularly favorable environment or the organism will not continue to live. It may truly be said that for most pathogenic organisms the only perfect environment is found in the human or animal body or in the bacteriological laboratory. Remember, therefore, in your battle against disease that sunshine and sun-heat are your most powerful protectors in nature, and that these defenses are destroying every moment myriads of the worst enemies of mankind. Do not neglect these allies. Use them every day. Never be without them.

But do not forget that these natural germicides—sunlight and sun heat—can not destroy germs instantly. Their action takes time—minutes, hours or days. So we must not depend upon these protective agents alone. We must do our part to protect ourselves. After all has been said, it remains true that the germs of typhoid, tuberculosis, syphilis, lockjaw, influenza, boils, abscesses, gangrene, hookworm, amebic dysentery and many other diseases may be lurking here and there in dark, damp, warm, and dirty places, and sometimes in the dry and dusty places that lie near our homes, our places of work, our restaurants, and our places for play. The fly that travels from the

sewer may carry infectious excrement from a typhoid patient to the food on your table. The dirty hands of the careless milkman may transmit scarlet fever from his children to you by way of the milk you buy from him. Your drinking water may bring you typhoid, and the dust in the air may bring you influenza. We can not leave the matter of our defense against disease to nature alone. We must do our share. We must help defend ourselves and our communities against disease.

IV

SOME OF THE NATURAL DEFENSES SUPPLIED BY THE HUMAN BODY

The Surface Defenses of the Human Body (the Walls of the City)

The Skin.—We know that very few disease organisms can gain access to the tissues through the normal healthy skin. Pathogenic organisms can enter only through scratches, punctures or other destructive wounds. The young hookworm is a noteworthy exception.

The Mucous Membranes.—Many organisms live and produce upon the warm, moist mucous surfaces of the alimentary canal, the respiratory canal, and other natural openings and channels of the human body connected with the exterior. But it seems to be true that most of those organisms are unable to pass through the mucous membranes unless some injury has occurred to make an opening through which they can enter. For example, the mouth-breather, the child or man with nasal obstruction, chronic nasal catarrh, adenoids or tonsils, is permitting an injury to the lining of his air passages so that disease organisms may more easily enter. In this way dirty gums, sore gums, and decayed teeth help pathogenic organisms in their battle against your health. Constipation and indigestion are making microscopic openings in the intestinal wall that defends you against your enemies.

The Natural Secretions are Often Your Protectors.—The glands of the eyes secrete a fluid—the tears—which is continually washing the surface of the eyes and is carried away through a canal into the nostrils. The secretions of the nose, throat and lungs mechanically exercise a cleansing effect upon these mucous walls. We excrete this material when we expectorate. The secretions of the eyes, the nose, the mouth, and the throat have a mildly antiseptic action. The gastric juice has a somewhat stronger antiseptic influence.

Ciliary Movement.—The passages of the nose, throat and larger air passages are covered with small hairs which filter the inhaled air, and

which, at the same time, gently, slowly, but unceasingly push the moisture, the excretions, the foreign bodies, germs, etc., on and out of the respiratory tract. This ciliary action is present in other parts of the body.

Remember, then, your skin and your mucous membranes protect you from disease. Take care of them. Keep them in health. Do all you can to help them in defending you. Keep your skin clean and healthy. Keep your teeth clean. Keep them from decay. Keep your gums clean. Watch your digestion. Don't allow yourself to become constipated.

Remember, too, that the glands of the eyes and the cilia of the air passages are working to keep you well. You must do all you can to help them. Keep your eyes clean. Keep your nasal passages free. Remove abnormal growths of the nose and throat. A healthy nose and throat is a defense against disease.

V

THE INTERNAL DEFENSES OF THE BODY

While the germs of the disease are on the skin or on the mucous membranes of the eyes, the respiratory or the digestive tracts, they are really outside the human body. If they gain access to the tissues through injuries of the skin or the mucous membranes, there are still other agents present within the tissues themselves that are active in your defense against disease. The most important of these defenses may be described as follows:

The Phagocytes.—(*a*) Principally the white blood corpuscles. The action of these cells may be observed under the microscope. Such observation shows that one of these cells will ingest a bacterium and slowly dissolve it. A single white cell may, in a short time, be seen to destroy a number of bacteria. Under normal conditions there are between 5,000 and 8,000 white blood corpuscles in a single cubic millimeter of human blood. In some diseases this number is very greatly increased, and there may be 40,000, 50,000 or more, rarely over 100,000 per cubic millimeter. (*b*) There are other circulating cells of the body which have this phagocytic action. (*c*) Significance of phagocytosis as a defense against disease.

Bacteriolysis.—(Destructive action of blood serum and tissue juices upon bacteria.) When typhoid bacilli are placed in normal human blood serum and observed under the microscope, it is soon noted that the bacilli gradually dissolve. This process is called bacteriolysis.

Human blood has a bacteriolytic effect upon the typhoid, anthrax, colon, dysentery, cholera, and probably other bacteria.

Remember: Phagocytosis and bacteriolysis are processes by means of which the tissues of the body may destroy bacteria and thus protect themselves from disease.

Inflammation as a Defense Against Disease.—When a number of bacteria gain access to the tissues at any given point, there is normally an inflammatory reaction at that point. The features of the reaction which interest us are: (1) The increased blood supply which brings phagocytes and bacteriolytic serum to act on the invading organisms; (2) there is a proliferation of the local and circulating tissue cells which on the one hand produces phagocytes and which on the other hand builds a wall of cells about the invading organism. The story of inflammatory reaction is longer than I have time to relate. But these several facts serve to illustrate its protective character.

VI

ACQUIRED IMMUNITY

So far in our discussion we have been concerned mainly with factors in what is called natural immunity. We have been considering the bodily defenses that are always present in the normal healthy individual. These defenses are frequently overcome by disease, and pathogenic organisms then establish themselves in the tissues of the body as in pneumonia, tonsilitis, diphtheria, and so on. Under these conditions the body usually acquires a new internal defense which enables it to destroy the invading pathogenic bacteria and expel them. We then say, "The disease has run its course. He is well." Sometimes this acquired defense is so strong that it becomes permanent. Men do not have smallpox a second time. We call this defense against disease "active acquired immunity."

The mechanism of this process by means of which the animal body is able to organize a new and powerful defense against disease is one of the wonders of physiology. I can do no more than point out to you a very few of the more important facts, but I would urge you to go deeper into this marvelous story if ever the opportunity arises.

When an infecting agent, like a pathogenic bacterium, establishes itself in the tissues, it appears to have an irritating influence upon some or possibly all the fixed and circulating cells of the body. This irritating or stimulating influence may be due to soluble chemical excretions or secretions given off by the living pathogenic organism, or it may be

due to soluble chemical particles arising from the disintegration of the dead bodies of the invading pathogenic organisms. These chemical bodies are carried about by the blood stream and are thus brought into contact with the various tissue cells in all the organs of the body. And then a remarkable thing happens. The irritation of these tissue cells seems to stimulate some, possibly all of them, to produce specific anti-bodies which destroy the infecting organism or neutralize the toxic products of its activity.

We call the soluble chemical agents that cause the tissue cells to produce these antibodies "antigens." An antibody which neutralizes a toxin we call an "antitoxin." A toxin is an antigen which causes the production of an antitoxin. An antigen which causes the production of a lysin we call a "lysogen." We know a number of well-established groups of antigens and their corresponding antibodies. For our purposes the most important of these are the toxins, the lysogens, and the opsogens, and their antibodies, the antitoxins, the lysins and the opsonins.

The toxins are antigens and are soluble poisons usually produced by pathogenic bacteria. The toxins of diphtheria and of lockjaw are poisons of terrible power. Each has an antitoxin.

The lysogens are antigens which cause the tissue cells to produce lysins. Typhoid bacilli produce lysogens. When they are present in the tissues they cause the appearance of lysins which dissolve and destroy typhoid bacteria. Lysins that destroy bacteria are called bacteriolysins.

The opsogens are of great importance and are, in addition, unique in their mode of action. The opsogens cause the appearance or production of opsonins. The opsonins are important because without them the white blood corpuscles do not exercise their powers of phagocytosis.

Remember: When disease organisms establish themselves in the tissues they act as general tissue cell irritants. Under the influence of this general irritation the cells of the body produce anti-bodies which destroy the invading organisms or neutralize the poisons which those organisms produce. In this manner the cells of the human body respond to the call "to arms" and defend themselves from destruction through disease.

VII

ACQUIRED IMMUNITY—*Continued*

Source of Antigens.—Antigens are soluble protein bodies concerning which much yet remains to be learned. The antigens that interest us are those that are formed by pathogenic organisms.

Extra-cellular Antigens.—We know that some antigens are released by such organisms in their excretions and secretions. Antigens given off in this manner may be called extra-cellular antigens. Several of the toxins given off by the diphtheria bacillus are extra-cellular antigens. Toxins of this sort are frequently called ectotoxins or exotoxins.

Intra-cellular Antigens.—It seems to be true, too, that many pathogenic organisms contain poisonous substances that are structurally parts of those organisms and are released only when those organisms die and become disintegrated. These intra-cellular poisons then go into solution and may then act as antigens. Such antigens may be called intracellular antigens. The existence of antigens from this source has not been proven but there is ample indication that there is such a source.

We may summarize our statements on the sources of antigens by saying that the antigens manufactured in infectious diseases are given off in the secretions or excretions of living pathogens or they are dissolved out of the dead bodies of such organisms.

Sources of Antibodies.—Metchnikoff has voluminous evidence that the antibodies are products of the white blood corpuscles and other phagocytes. Ehrlich supports the view that the connective tissue cells are the chief sources of the antibodies. It is probably true that antibodies are manufactured by all active tissue cells under varying circumstances.

Active and Passive Acquired Immunity

Acquired Immunity May Be Active or Passive.—The animal (or man) that is protected by antibodies of its own manufacture is protected by an active acquired immunity—or rather by an immunity which it has acquired actively.

Passive Acquired Immunity.—On the other hand, when an animal (or man) is protected by antibodies which have been transferred to it from some other animal, in the tissue cells of which those antibodies were manufactured, we say that animal has been protected by an immunity which it acquired passively.

Active acquired immunity is the defense which an individual manufactures within his own tissues to save him from a specific infection. Passive acquired immunity is the defense which an individual may acquire through the injection into his tissues of defenses manufactured by the tissues of some other animal. The factors in immunity acquired actively by one animal may, therefore, be used passively by another animal.

Our surface defenses and certain of our internal defenses operate to prevent our becoming sick. The skin, mucous membranes, the

cleansing and antiseptic secretions, the cilia, the phagocytes, the lysins, and other less well-known agents of natural immunity participate in this defense.

The antibodies are the internal defenses which we organize to save us from destruction when our natural surface and internal defenses have proven insufficient to protect us from invasion by pathogenic organisms. Recovery from infectious disease depends upon this acquired immunity. Death comes when the acquired immunity (*i.e.*, army of antibodies) is not strong enough—quantitatively or qualitatively—to overcome the invading pathogenic organisms and their poisonous antigens.

This acquired internal defense is remarkable in many respects. (*a*) It is a specific defense. The antibodies manufactured for defense against the poisons of diphtheria will not offer any defense against the poisons produced by the bacillus of typhoid fever or the treponema of syphilis or from any other source. (*b*) This acquired defense may last for a very short time and then disappear as in diphtheria. It may leave behind it an increased susceptibility to the pathogenic organism against which it was developed as in influenza or pneumonia. It may leave a sensitiveness which enables the tissue cells to manufacture new antibodies against the same disease more rapidly than before the first attack as in cholera. It may last a long while as in smallpox or measles.

VIII

ANTIGENS AND ANTIBODIES IN ACTION

As found in an attack of diphtheria. Diphtheria is a common disease. Over 1,200 persons died of this disease in New York City in 1918. There were over 11,000 cases in this city in 1918. It is caused by the diphtheria bacillus. This pathogen most commonly locates itself in the throat. When the bacillus of diphtheria establishes itself in the human throat, if conditions are favorable, it reproduces very rapidly, so that in a few hours there may be many millions of new bacilli. Each one of these living organisms takes its food from the tissues in which it is located. This tissue is the mucous membrane of the throat. All of its excretions and secretions are deposited in that same tissue. When the organism dies its body disintegrates and its chemical structure dissolves in the fluids in which it has been living. These soluble chemical products of the life and death of the diphtheria bacillus are carried by the blood and lymph circulations to every organ, every tissue, and

every tissue cell of the human body in which the bacilli have been permitted to grow.

Several of the soluble chemical products of the life and death of the diphtheria bacillus may be noted as follows:

Toxins.—The bacillus produces several toxins. The chief toxin is known as the diphtheria toxin. As a matter of fact, this "toxin" is a group of toxins, some of which are less poisonous than others. (Rosenau defines a toxin as "a specific poison elaborated by bacterial metabolism." The common use of the term gives it a much looser definition as a poison of microbic source.) The toxin of diphtheria is particularly poisonous. One cubic centimeter of a filtered bullion culture (about the contents of a small-sized thimble) contains enough poison to kill 2,000 average-sized guinea pigs. Before the days of antitoxin treatment of diphtheria this toxin destroyed from 20 per cent. to 50 per cent. of all the children infected with the diphtheria bacillus.

Antitoxins.—The toxin of diphtheria acts as an antigen stimulating the tissue cells (the phagocytes—Metchnikoff; the connective tissue cells—Ehrlich) to produce antibodies known as antitoxins. Recovery from diphtheria depends upon the neutralizing of the toxin of the diphtheria bacillus by this antitoxin. These antibodies (the antitoxins) are factors in active acquired immunity. They are nowadays supplied the individual by the physician and thus offer a passive acquired immunity.

Since the introduction of the antitoxin treatment of diphtheria, death from that disease has been greatly reduced. "Bayoux makes the statement, based upon an analysis of 230,000 cases, that the death-rate of diphtheria before antitoxin was 55 per cent., and that since the advent of the serum it has fallen to 16 per cent." (Osler's Modern Medicine, first edition, Vol. II, page 340.)

The earlier the antitoxin is used the more certain is its action. This is shown in the following statistics:

REPORT OF THE STATE BOARD OF HEALTH, MASSACHUSETTS, 1902

In 1433	cases,	antitoxin	given	1st	day	on	which	case	was	seen,	mortality	7.9%
In 3284	"	"	"	2d	"	"	"	"	"	"	"	6.2%
In 2654	"	"	"	3d	"	"	"	"	"	"	"	9.0%
In 1684	"	"	"	4th	"	"	"	"	"	"	"	12.9%
In 864	"	"	"	5th	"	"	"	"	"	"	"	15.9%
In 1242	"	"	"	6th	"	(and later)		"	"	"	"	17.6%

Lysogens and Lysins.—It seems to be well established that there are antigens produced by the diphtheria bacillus which cause the tissue cells to produce specific bacteriolysins. We do not know how im-

portant the bacteriolysins of diphtheria are, but we believe that they take a more or less effective part in the defense of the body against the diphtheria bacillus—that is, in recovery from diphtheria.

Opsogens, Opsonins and Phagocytes.—The soluble chemical products of the life and death of the diphtheria bacillus contain an antigen which is called an opsogen. This antigen when distributed in the blood stream causes certain of our tissue cells to manufacture a specific opsonin for the diphtheria bacillus. The specific opsonin for the diphtheria bacillus attacks this bacillus in some, at present, unknown way, and causes that organism to become susceptible to the phagocytes (white blood cells), so that these phagocytes will then engulf diphtheria bacilli and destroy them. We are justified in believing that the opsogen of diphtheria is of great importance in its productive relation to the opsonin of diphtheria and, therefore, to the specific phagocytosis of diphtheria. The number of phagocytes (white blood cells) in the blood is greatly increased in the majority of cases in diphtheria. This increase is well marked by the third day of the disease. The number of white cells may then have increased from 3,000 to 4,000 per cubic millimeter to such enormous numbers as 38,000 per cubic millimeter (Billings), or 46,000 (Morse), or 75,000 (Bonchut), or 148,229 (Felsenthal). (See R. C. Cabot, Clinical Examination of the Blood.) These phagocytes may each take up from 30 to 50 bacilli.

Possibility of there being a production of unknown antigens by the diphtheria bacillus with consequent unknown antibodies produced by the human tissue cells.

There may be other extra-cellular antigens which we have as yet been unable to identify. Their antibodies are, of course, not known There may be intra-cellular antigens of the diphtheria bacillus which are dissolved and released into the blood stream when the dead bacillus is destroyed either by lysins or through phagocytic digestion.

Possibility that the human tissues produce "antigens" which cause the diphtheria bacillus to produce "antibodies." The human antibody is produced for defense against certain germs. It seems to be true that the germs may produce antibodies of their own which protect them against the human being.

Aggressins.—It often happens that the bacillus of diphtheria shows an unusual virulence. This may be due to the fact that it is stimulated to produce active defenses against its human host. Those defenses are called aggressins. The indications are that living, virulent microbes excrete or discharge substances which are not toxins proper but which, nevertheless, have an inhibitive or "anti" action upon the cells of the organism. (Adami.) "It may, indeed, be suggested that the ag-

gressins are to the bacterial organism what the opsonins are to the animal." (Adami.) And so while the tissue cell is manufacturing specific defenses against the diphtheria bacillus, the bacillus is manufacturing specific defenses against the cell. Each one is producing chemical bodies which are antigens to the other and antibodies for itself.

Summary

(*a*) The bacillus of diphtheria injures and destroys human life with the following agents (antigens): (1) Toxins; (2) lysogens; (3) opsogens; (4) aggressins; (5) various unknown, extra-cellular and intra-cellular products.

(*b*) The human body may be defended against the diphtheria bacillus. (1) Actively, by specific (*a*) antitoxins, (*b*) bacteriolysins, (*c*) opsonins and phagocytes, (*d*) anti-aggressins, (*e*) various other unknown antibodies. (2) Passively, by (*a*) antitoxin manufactured in another animal—usually a horse—and injected into the circulation. (3) Neither the active nor the passive defense remains long after the disease has been cured.

Conclusion

(*a*) Our natural immunity protects many of us so that we never have diphtheria. It is not strong enough in some persons to protect them and as a result we have from 11,000 to 12,000 cases a year in New York City.

(*b*) Our powers of active acquired immunity have been able in the past to save from death only from 50 to 80 per cent. of all persons infected with the diphtheria bacillus.

(*c*) Our powers of active acquired immunity, assisted by the immunity we have been able to secure from commercial antitoxin (passive acquired immunity), have been able to save from death from 84 to 93 per cent. of the human beings who have had the benefit of this combined defense. It is believed that a very early use of diphtheria antitoxin would save life in nearly every case.

IX

PERSISTENT IMMUNITY

The antibodies which we have discussed under diphtheria and lobar pneumonia produce only a transient immunity. Repeated infections with diphtheria bacilli or with the various strains of pneumococci are common. The immunity produced in defense against these organisms

lasts for a short time only. The immunity produced in bronchitis, tonsilitis, and common colds, is transient. In some cases one attack of disease seems to predispose the individual to subsequent attacks. This is especially true of lobar pneumonia, influenza, erysipelas, bronchitis and malaria.

A more lasting immunity occurs after the following diseases: Smallpox, yellow fever, measles, whooping-cough, scarlet fever, cerebro-spinal meningitis, infantile paralysis, typhoid fever, typhus fever, chicken-pox and mumps. In these infections the tissue cells produce antibodies which may remain in the blood and tissue juices for longer periods of time. It is more probable that in these cases the cells continue producing specific antibodies for months or years after recovery. We have not yet learned the details of the campaign of offense and defense in these various infections. We feel safe in deciding that it is a campaign in which antigens and antibodies participate in the various characteristic ways already pointed out in these lectures. We have, therefore, a general understanding of these methods of warfare, though we do not know all the details of any specific campaign.

The Use of Antibodies for the Protection of the Community Against Disease

Our knowledge of immunity has shown us various ways in which we can aid the individual to recover from certain diseases and with which we can protect the individual and the community from certain epidemics. The use of passive acquired immunity for the reduction of mortality from diphtheria has been discussed above.

Immunity Against Smallpox.—The immunity produced by vaccination against smallpox is an active immunity developed by a mild disease —cowpox—against cowpox, and also against the very much more serious disease, smallpox. Such vaccination causes vaccinia (or cowpox) in the human. The human being who has had vaccinia is absolutely protected thereby against smallpox for a period of from two to seven years. The experience of over one hundred years offers convincing proof of the pronounced difference in the mortality and morbidity from smallpox in the vaccinated and the unvaccinated. The following table from Schamberg shows that, among thousands of cases of smallpox occurring in cities all over the world, the death-rate from smallpox has been from five to sixteen times greater among the unvaccinated than among the vaccinated:

DEATH-RATE FROM SMALLPOX AMONG VACCINATED AND UNVACCINATED IN VARIOUS COUNTRIES *

Place and Time of Observation	Total Number of Cases Observed	Death Rate per 100 Cases: Among the Unvaccinated	Death Rate per 100 Cases: Among the Vaccinated
France, 1816-1841	16,397	16.125	1.
Quebec, 1819-1820	2	27.	1.66
Philadelphia, 1825	140	60.	0.00
Canton Vaud, 1825-1829	5,838	24.	2.16
Verona, 1828-1829	909	46.66	5.66
Milan, 1830-1851	10,240	38.33	7.66
Bresleau, 1831-1833	220	53.8	2.11
Wurttemberg, 1831-1835	1,442	27.33	7.1
Carniola, 1834-1835	442	16.25	4.4
Vienna Hospital, 1834	360	51.25	12.5
Carinthia, 1834-1835	1,626	14.5	0.5
Adriatic, 1835	1,002	15.2	2.8
Lower Austria, 1835	2,287	25.8	11.5
Bohemia, 1835-1855	15,640	29.8	5.16
Galicia, 1836	1,059	23.5	5.14
Dalmatia, 1836	723	19.66	8.25
London Smallpox Hospital, 1836-1856	9,000	35.	7.
Vienna Hospital, 1837-1856	6,213	30.	5.
Kiel, 1852-1853	218	32.	6.
Wurttemberg (no date)	6,258	38.9	3.5
Malta (no date)	7,570	21.07	4.2
Epidemiological Society Returns (no date)	4,624	23.	2.9

* Extract from papers prepared in 1857 by Sir John Simon, Medical Officer of the General Board of Health of England, and at that time laid before Parliament with reference to the History and Practice of Vaccination. Published in first Report of the Royal Commission on Vaccination, 1889, Appendix 1, p. 74. (From Preventive Medicine and Hygiene, by Rosenau, p. 29.)

The United States authorities vaccinated 3,515,000 persons in the Philippine Islands during the few years of their control without a single death from the vaccination itself. The discomfort and injury that sometimes follow vaccination is due to carelessness in the treatment of the vaccination sore. If such sores are treated aseptically—as all wounds ought to be treated—they remain innocent and harmless.

Immunity Against Rabies.—The Pasteur treatment of rabies develops an active immunity in the individual by repeated short interval infections with attenuated (weakened) organisms of rabies. Of 54,620 persons treated early at twenty-four Pasteur Institutes, less than 8 per cent. died of hydrophobia. In Hungary, between 1880 and 1885, 5,899 persons were bitten and 4,914 received the Pasteur treatment. Two per cent. died among those treated. About 14 per cent. of all persons bitten by rabid dogs and who are not given the Pasteur treatment die of hydrophobia.

Immunity Against Typhoid.—Immunity against typhoid fever last-

ing from three to five years is produced by the injection into the tissues of emulsions of dead typhoid bacilli. Vaccination against typhoid fever is now practiced in various armies, numerous hospitals, and by many wise individuals. The results have been universally satisfactory. In continental United States, in 1908, one person in every two hundred had typhoid fever. In our Spanish-American War, out of 107,000 troops, 20,000 had typhoid fever. In 1911 anti-typhoid vaccination was given 12,801 soldiers at San Antonio, Texas. Only two cases developed. One had not been vaccinated and the other had been infected before vaccination. In the small city of San Antonio at that same time there were 49 cases of typhoid fever with 19 deaths. The incidence of typhoid fever in the British Army in India is 1.7 per 1,000 among the vaccinated and 5.3 among the non-protected. (Before the Great War.) If the American Expeditionary Force (2,000,000 men) had not been vaccinated against typhoid fever and if the same rate of infection with typhoid had occurred as did occur in our Spanish-American War there would have been 384,113 cases and 29,266 deaths from typhoid in our American Expeditionary Force.

This protective treatment of typhoid fever has apparently very little danger attached. Sometimes fever and discomfort follow such "vaccination," but when they are the results of the vaccination they are never serious.

Protective methods of treatment like these have been or are being devised for pneumonia, tetanus, cholera, bubonic plague and other diseases.

It is obvious that the products of immunity reactions are of the greatest value in the protection of individual and public health. Immunity is more than a defense which the individual manufactures unconsciously for his own protection. It is now a protection which may be intelligently guided, directed and reinforced for personal and community benefit.

The market is full of serums for the prevention and treatment of disease. It is always unwise to try new medication until its value has been established by scientific medical authority.

X

DEFENSE OF HEALTH THROUGH HYGIENE

General Laws of Personal or Individual Hygiene

Everything that lives is capable of good health, poor health, or disease. In general, the physiology of animal life and the physiology of

plant life are the same and the laws that govern the health (physiological efficiency) of all forms of life, simple and complex, are much the same. Under these laws, the health of every living thing is dependent upon (1) the remedy and correction of physical defects; (2) adequate nourishment; (3) the effective removal of waste products; (4) normal exercise of normal functions; (5) recreation, play and rest, and (6) the avoidance of injury. No policy of personal health control can be successful if any one of these requirements is neglected. Wise habits of exercise will not lead to good health if the individual has bad habits of rest. The man that exercises wisely and rests wisely but pays no attention to a mouth full of decayed teeth can not expect to be in the best of health.

Furthermore, these same laws apply in a general way to the health problem of every living cell, whether of animal or vegetable origin. Some animal and plant organisms are very complex, others are relatively simple. The ameba is a simple one-celled animal. The same general laws of health govern the one cell of the ameba and each of the many millions of cells of which the individual human is made. Each one of those cells is an individual requiring the repair and correction of physical defect, nourishment, exercise, the removal of wastes, rest, and protection. A great army of our tissue cells are grouped together to form our voluntary muscles. Millions of other cells are combined and organized into our brain and nerves. A host of bone cells form the skeleton. Myriads of other special cells make the skin. The stomach and intestines are lined with an infinite number of gland cells which secrete the juices with which we digest our food. The heart is a bundle of specialized muscle cells. These and other specialized cells in your body and mine are living together in a great community obeying the same laws of repair, nourishment, exercise, rest, and protection.

The large tissue masses that form our voluntary muscles are made up of great numbers of muscle fibres. Each fibre is a delicate, complex thread of tissue. The longer fibres may measure an inch in length; the diameter may be as little as one five-hundredth of an inch. Each fibre is a distinct individual. It receives food from the blood fluids with which it is surrounded. It builds its own structure out of this "food." From this same supply it manufactures and stores up the chemical substance or substances with which it does its work. When there is work to be done these stored-up chemicals become active and in some marvelous way the fibre is made to shorten and the muscle contracts. These chemical events are accompanied by the formation of chemical products or wastes which would poison the fibres, and other tissues too, if those wastes were not quickly removed or neutralized.

These wastes pass from the fibres into the lymph and venous blood streams which drain the muscles and are neutralized by agents in the blood; or they are carried by the blood to the excretory organs, chiefly the lungs and kidneys. When all the health habits of the muscle fibre are good habits the fibre will be healthy, efficient and strong. If it does no work or takes no exercise it will degenerate and atrophy. If it is bathed in a sluggish lymph or blood stream that is never stirred up by exercise, it will be poisoned by the injurious chemical products of its own vital activities. If it has no rest, it will be unable to repair its structural injuries or replace its functional losses. Any of these bad habits of muscle-fibre hygiene may be sufficiently injurious to make the fibre weak and unhealthy.

The same description applies with but little variation to all the tissue cells of the human body.

XI

DEFENSE OF HEALTH THROUGH HYGIENE—*Continued*

From what has been said it is evident that the general problems of personal health—the problems of resistance and defense of the human body against disease—are problems of repair, nourishment, excretion, exercise, recreation, play, rest, and protection.

The defense of the individual through the repair and correction of physical defects has been discussed with the contributory causes of disease.

The protection of the individual from the various causes of disease and injury has been discussed with the agents that injure health.

Defense through adequate nourishment. Every tissue cell and every organ must be adequately nourished in order that the human being of which it is a part may be in resistant health. Adequate nourishment depends on (*a*) the digestibility of the food; (*b*) its composition; (*c*) its preparation; (*d*) the amount eaten; (*e*) conditions under which the food is eaten; (*f*) habits of mastication; (*g*) condition of the digestive tract; (*h*) the after-meal habit of the individual.

The Digestibility of Food.—Experience has taught us that the following foods are usually not easily digested: Fried foods and all greasy foods; corned beef and cabbage; soft, hot breads, rolls, and cakes; very sweet foods; uncooked bananas. On the other hand, we know that one individual may digest easily a food that another can not digest at all. It follows, then, that each individual must learn by experience what his digestive possibilities and limitations are. Some humans thrive on corned beef and cabbage; others are unable to handle milk.

The daily dietary should contain a mixture of protein, fatty and carbohydrate food, with normal saline constituency, fruit, and water. Protein food is found in meats, fish, eggs, milk, cheese, and some vegetables, such as peas, and beans. Carbohydrate food is furnished in larger quantities by the various cereals and vegetables. Bread is our chief source of carbohydrate food. Fat is found chiefly in butter, meats, and oils. The salts present in meats, fish, vegetables, cereals, and water are ordinarily adequate to meet the needs of the tissue cells. We habitually salt many of our foods in order to make them more palatable. In doing this we at the same time furnish saline "food" to the tissue cells. Fruit foods and water as a "food" need no further comment here in this connection.

A food of relatively easy digestibility and containing ample nourishment may be made difficult of digestion through careless or unwise preparation. Fried food is more difficult of digestion than less greasy food. The cooking may make the food tough, leathery, or hard, and therefore, not easy to masticate. Poor cooking produces soggy, sticky food that is unpalatable and hard to digest. The aim of cooking should be to destroy the organisms present in the raw food; to make the food more digestible through the action of heat on the food, and to produce a pleasing, appetizing result.

The amount of food one should eat varies with age, occupation, weight, and general condition. The very young and the old need less food than the robust, active adult. The miner needs more food than the stenographer; the big man more than the small man; and the well man more than the sick man. Under ordinary circumstances it is unwise to limit the diet to one sort of food. It should be a mixture of the several varieties of food. There should not be an excess of protein. Milk, eggs, and cheese furnish a safer protein food than do the meats because they contain a lesser amount of the purin bodies. These bodies add to the labors of the kidneys and the liver.

The conditions under which food is eaten have a great deal to do with its digestion and, therefore, with its nutritional service. Disagreeable emotions depress or stop the secretion of digestive juices and the movements of the digestive tract. Agreeable emotions, especially those associated with food, encourage and stimulate such secretions and movements. Attractive table service, appetizing odors, sightly foods, pleasant company, and general conversation are conditions that help digestion and lead to better nourishment.

Food that is eaten slowly and thoroughly chewed is more easily and rapidly digested than that eaten in chunks. Leisurely eating with effective mastication is a logical accompaniment with the conditions of

good cheer discussed in the preceding section. One can not secure favorable meal environment and good digestion if he hurries to his meals, through his meals, and from his meals.

The problems of nourishment are complicated in all cases in which gastric or intestinal indigestion exists. Such indigestion is frequently the result of mistakes made by the individual. The treatment is usually concerned with the quality of the food, its digestibility, its composition, preparation, quantity eaten, conditions under which it is eaten, and the after-dinner habits of the eater. Nervous irritability is perhaps the most common cause of indigestion.

The after-meal activities of the individual have much to do with the digestion of his food. Heavy muscular exercise at such a time is accompanied by a cessation of all digestive movements. Disagreeable emotional states bring on the same results. Each meal should be followed by an interval of quiet, pleasant relaxation, or at most, only light exercise. The appropriate duration of this period must vary with different individuals and at different times with the same individual.

XII

DEFENSE OF HEALTH THROUGH HYGIENE—*Continued*

Defense through excretion. The health of every tissue cell depends further upon its relief from the influence of chemical products of its vital activities and the chemical products of the vital activities of other tissue cells. Muscular exercise is the most powerful agent concerned in the more rapid and effective removal of wastes. This result is accomplished through the effect of muscular exercise on the movement of the blood stream, and on the respiratory activities of the lungs. The secretions, excretions, and wastes from the tissue cells finally leave the body by way of (*a*) the respiratory tract, (*b*) the skin, (*c*) the bowels, (*d*) the genito-urinary tract. The excretory activities of the lungs and the kidneys are the most important. The regulation of these functions: (*a*) The lungs should be well ventilated with clean, fresh air; (*b*) the kidneys are likely to do their work better and with less injury to themselves when one drinks six or eight glasses of water a day and eats meat only in moderation; (*c*) the bowels should move naturally and effectively at least once a day; (*d*) and a moderate sweating with regular bathing and clean underclothing are likely to keep the skin in a healthy condition. Regular and reasonable habits of muscular exercise and bathing give us our best method of regulating these various excretory functions.

The health of every tissue cell and, therefore, the health of every

organ and of every human being depends further on the exercise of the normal function of the tissue cell. Eyes that never see lose the power of vision. Children that never hear do not learn to talk. Nerve cells that are not used do not develop but rather deteriorate. Muscles that do not work grow small and weak. We exercise most of our tissue cells and organs to some extent at least because we have to. The heart does its work regardless of what we think about it. We can't help breathing. We feel, see, hear, taste and smell, and thus exercise the organs concerned, without any deliberate plan for their exercise. The exercise of the nerve cells concerned with mental activity has become one of the responsible burdens of society. It is through the wise exercise of these cells that healthy, educated minds are produced, and it is for this purpose that schools have been established and various systems of education applied the world over.

The muscles need exercise as much as the nerves do. They are too often neglected with injury to themselves and with injury to the general health of the whole body. Regular, interesting, muscular exercise should be a part of the daily routine in every human life. The beneficial effects of such muscular activity are far-reaching and most valuable in their influences on health. Through general muscular exercise we are able to affect the nourishment, excretion, and exercise of practically the whole great community of tissue cells that form the human body. The effects of exercise may be summarized as follows:

(*a*) An immediate, transient, local increase in the blood supply of the muscle.

(*b*) An immediate, transient, local increase in the lymphatic and venous drainage of the muscle.

(*c*) An immediate and transient increase in the heart rate, blood pressure, and rate of respiration.

(*d*) An immediate and transient increase in the superficial circulation.

(*e*) A later, more lasting increase in the size, strength and functional endurance of the exercised muscle.

(*f*) A later, more lasting decrease in the length of the exercised muscle.

(*g*) A later, more lasting increase in the size and strength of the tendons, ligaments, sheaths, bones, and joints directly associated in exercise.

(*h*) A later, more lasting increase in the size and efficiency of the nerve cells in the exercised motor centres.

(*i*) An improvement and perfection of old neuromuscular coordinations.

(*j*) The establishment of new neuromuscular coordination with the possibility of developing new parts for the afferent and efferent nerve impulses.

(*k*) An increase in the size, strength, functional endurance and efficiency of the heart.

(*l*) An improvement in the regulation of the vasomotor balance.

(*m*) An improvement in the blood and lymph circulation.

(*n*) An increase in the strength, endurance, and coordination of the musculature of respiration.

(*o*) An improvement in the depth and the rhythm of the thoracic and diaphragmatic movements governing the ventilation of the pulmonary alveoli, and augmenting the speed of the general lymphatic and venous circulation.

(*p*) An improvement in the operation of the heat-regulating mechanisms.

(*q*) A perfection of the mutual neuromuscular coordinations associating cardiac, circulatory, pulmonary, and vasomotor activities.

(*r*) An increase in general katabolic activity.

(*s*) An increased circulation of the products of the chemical activities of all the tissues and organs associated directly and indirectly in physical exercise.

(*t*) A larger hormone effect of these products (among them carbon dioxide, acid potassium phosphate, sarcolactic acid, ammonia, creatin, and the endogenous purin bases).

(*u*) An increase in the elimination of carbon dioxide by the lungs; of water and carbon dioxide by the skin; of uric acid and creatin by the urine.

(*v*) A desire for rest after exercise, and a desire for sleep at the end of the day.

(*w*) An improved appetite, better digestion, more food in the blood for the tissues, a greater demand for food by the tissue cells (a benignant circle).

(*x*) An increase in the anabolic activities of all the tissues concerned directly and indirectly in exercise, with, therefore, a general structural and functional benefit.

(*y*) A gain in weight or in increased growth, or both, continuing until the metabolic equilibrium is re-established.

(*z*) A perfection of the physiological efficiency of the whole organism, with consequently

(*aa*) A better development of the powers of potential and active immunity. (Storey in Hare's *Modern Treatment.* Vol. 1, p. 192.)

XIII

OUR DEFENSES AGAINST FATIGUE

All living things require appropriate and adequate periods of rest. Every active moment in the cells, tissues and organs of the human body is a moment in which the living cells use up their stores of energy and subject themselves to structural wear. Every passive moment is used by these same cells for recuperation and repair. Wherever there is life there must be chemical change, with the formation of various chemicals, some of which are appropriately called waste products (fatigue products). If life is to continue there must be a restoration of the chemical substances used and a removal of the wastes formed. We find everywhere that nature has established resting periods of resting stages in which to counteract the effects of activity, that is, of fatigue. Rest is nature's treatment of fatigue.

There are three types of fatigue, which may be designated as (1) normal fatigue, (2) acute fatigue, and (3) chronic fatigue.

Normal fatigue or general fatigue is a summation of the normal daily fatigue of all the cells of the body. We rest, we sleep, in order to rest our muscle cells, our nerve cells, our gland cells, all of our tissue cells. Normal fatigue brings on a desire for rest and sleep. Fatigue that is not relieved by rest and sleep is not normal fatigue. Such fatigue is a symptom of poor health and is usually the result of bad habits of hygiene. If one is wise in his daily habits of health, if his habits of nourishment are good, if his habits of exercise are reasonable, if he takes good care of his excretions, if his habits of rest are right, he will accomplish his day's work with no left-over fatigue burden from yesterday and will pass no such burden onto to-morrow. Such a man is "fit" to-day because he lived right yesterday. He can depend on himself to-morrow because he is taking care that his tissue cells are properly fed, cleaned, exercised, rested and protected to-day. His fatigue is normal and transient because he is a normal, healthy human being.

If a muscle is made to lift a weight rapidly it soon tires. After a short interval of rest, a few seconds or minutes, perhaps, the muscle recovers and is able to do quite as much work as it did before. The trained athlete falls exhausted at the end of the hundred-yard dash. In a few minutes he is ready for another race. If the hod-carrier or the bricklayer or the coal-heaver speeds up his pace he soon tires. If he then rests he soon recovers. These are samples of acute fatigue. We may have acute fatigue of the heart, the lungs, of the eyes or the

ears, or any other active organ, which can be relieved by appropriate rest. Acute fatigue is often accompanied by injury when the activity causing the fatigue is sustained too long. This is especially true when the active organs are weak, malformed, or otherwise out of condition.

Chronic fatigue is brought on by careless health habits which prevent the removal of the fatigue effects of one day's work before the next day's work is undertaken. If one rests or sleeps too little there will not be sufficient time for the repair of injuries, the restoration of losses, and the removal of waste products. If one's nourishment is inadequate from any cause inside or outside the body, there will be insufficient material in the blood for restoration and repair. If the excretory activities are inadequate the accumulation of waste products (fatigue products) in the blood will subject the tissue cells to continuous injury and there will be no real rest. If one takes no exercise the processes of cell nourishment and cell excretion will be inadequate. Thus the persistent influence of a habitual neglect of any one of these health requirements makes it difficult or impossible for the tissue cells to recover from the losses that occur during each day's work. Under the influence of these bad health habits normal fatigue becomes abnormal fatigue, acute fatigue comes on more easily and is more likely to be harmful. Each day, then, inherits a fatigue injury from the day before and each day receives a health injury from the day before. The worker then finds himself "out of condition." He is always tired. The morning brings him a dark-brown taste and the world is colored yellow. His brain is dull. His head aches. He makes mistakes in his work. His efficiency is lowered. Sooner or later his health is broken and his job is gone.

Chronic fatigue comes with poor health habits. Chronic fatigue, poor health and poor morals are frequently associated. We sometimes discover fine character in association with the irritable disposition, bad breath and acne that comes with chronic fatigue, but we are not surprised if those symptoms are accompanied by various petty vices or even a few of grosser dimensions. Somehow we do not look for happy homes, well-trained children and satisfied parents when chronic fatigue has loaded the father or mother with a burden of mental worry, nervous indigestion and insomnia.

The stenographer or clerk whose monotonous days of close application are followed by nights of excited search for compensating pleasures are too often willing to sacrifice moral standards in that search. The occurrence of misconduct, low morals, petty vices and gross vices in company with fundamentally bad hygiene and chronic fatigue is common. There may be no scientific relationship, but the association is

there. The fatigue and health factors are in bad company and we are very liable to judge facts as we judge people—by the company they keep.

The lessons we have learned from the truant and unruly boy, the records of cases in our juvenile courts, reform schools and penitentiaries, the stories of our nervous patients, our insane and our suicides, all teach us that there is an intimate relationship between fundamentally bad hygiene, chronic fatigue and mental and moral irregularities, misconduct, and crime.

He that carries a heavy mental or physical labor and fails to lead a rational physiological life is not necessarily a criminal; he need not be immoral; he may support his load of fatigue and bad hygiene with moral success. He may be only tired, irritable, nervous and dyspeptic. But such men do not as a rule make the best husbands, the best fathers, nor the best citizens. Such men and women can not be relied upon to choose wisely between right conduct and wrong conduct. Their habits of relaxation and rest often bring no relaxation and no rest. The clouded judgment of poor health and chronic fatigue blurs clear vision and makes the choice of legitimate recreation difficult. The irritability, the restlessness, the dissatisfaction that come at the end of the fatiguing day, as a result of fundamentally bad hygiene, have led many a man and many a woman to search for recreation, for change and for pleasure where the recreation is a further drain, where the change is for the worse, and where the pleasure is immoral.

And so I would urge you most seriously to obey these several laws of health. Exercise wisely. Rest wisely. Give proper consideration to the importance of clean, healthful recreation and amusement. And I would insist that these important health habits should be combined with the wise health habits of nourishment, and excretion, and with an intelligent treatment of all injurious physical defects. A policy of personal health control which develops reasonable habits along these various lines is a policy which obeys the laws of all nature and must inevitably lead to a full realization of the health possibilities of the individual concerned.

Finally, I would point out to you the fact that you and I are dependent on the community in which we live in much the same way and for much the same reasons that our tissue cells are dependent upon us. If we supply these citizens of our bodies with the food they need, if we look after the removal of their excretions, if we give them reasonable exercise and rest, if we repair their injuries and protect them from harm, we are supplying them with the necessities of life. In the same way we, the citizens of another community—a community of humans—

depend on the social forces under which we live for our necessities. An army of human beings connects us with the garden, the dairy, and the farm, bringing us the food we must have. A myriad of laborers of all sorts provide us with the water we need. The work of many men is responsible for the removal of our excretions and wastes. A great group of teachers exercises the minds of our children so that they may grow in mental efficiency. Our institutions, municipalities, and commercial units are tending more and more to provide adequate opportunities for our normal physical exercise, recreation and rest. A band of public and private servants remedy our physical defects and protect us from disease, injury and violence.

XIV

CARE OF SPECIAL ORGANS

1. *The skin* is very likely to show the effects of malnutrition, defective excretion, lack of exercise, imperfect rest, and local injury. The care of the skin, then, involves the care of the general health, protection from mechanical, physical, chemical or parasitic injury. It further involves more specially, regular habits of exercise and bathing.

The sweat glands of the skin should be regularly active. Recreational physical exercise is the most attractive and on the whole the most effective means of securing this result. Such exercise should be followed by a bath. Bathing is a health habit of great importance; first, because it is necessary to cleanliness; and, second, because it is an effective means for the exercise of the muscular and nervous mechanisms concerned in the control of the blood supply to the skin—the exercise of the vasomotor mechanism in the skin.

One should bathe enough to keep clean. This may call for a bath a day, particularly in the summer time. The bath should not be of long duration, especially if the water is hot. The finish of a bath should be cool. A cold bath that is not followed by a warm glow on the skin is a bath to be avoided. A cold or cooler finish to the bath leaves the blood vessels of the skin stimulated and active, and, therefore, better able to protect the organisms against drafts and cold. Under such circumstances the skin is more likely to be a healthy skin and perform its various functions—excretory and others—effectively.

Some skins are sensitive to soap, and other cleansing fluids; even water itself is an irritant with some people. These rare cases call for the expert advice of a skin specialist.

CARE OF SPECIAL ORGANS—*Continued*

2. *Care of the Muscles.*—Recreational muscular exercise is one of our most important health habits. For various reasons it may be safe to state that it is our most important health habit because of its far-reaching influence upon the health habits of all the other organs of the body.

The best time for physical exercise is late in the morning or during the latter part of the afternoon. Most of us, however, must take our recreational exercise when we get the chance.

One should not exercise vigorously on a full stomach. There should always be an interval of comparative quiet after meals.

Exercise is more beneficial if taken out of doors with pleasant surroundings. Indoor exercise is better than no exercise.

The best exercises are those that are interesting.

Exercise should be regular. It should be sufficiently vigorous to stir up the circulation, increase the rate of breathing, and induce sweating. It should be followed by a bath and a change of underclothing if some sort of a uniform is not worn during the period of exercise.

3. *Care of the Nerves.*—A wise care of the nervous system involves other factors nowadays than those that operate in our educational systems. One's problem of "nerves" may be more difficult because of a heritage that has made him susceptible to nervous derangement. But with or without such a legacy it is important to protect one's "nervous balance" with wise health habits. The stability of the nervous system depends very largely on reasonably regular habits of daily life—habits of protection, repair, nourishment, excretion, exercise and rest. Nervous instability with poor nervous health may follow such influences as the misuse of alcohol; various infections, notably syphilis; certain metabolic diseases such as diseases of the thyroid gland and gout; abnormal modes of life; local injuries to the brain; suggestion; auto-suggestion; psychic contagion; strong emotions often repeated; disturbance of sleep; obsessing sexual images and thoughts; and excessive sexual activity. There is an alarming increase in mental and nervous disease in these modern times due to our high tension life, our various dissipations, neglect of regular living, and heredity.

XVI

CARE OF SPECIAL ORGANS—*Continued*

Care of the Vasomotor System.—The care of heat-regulating organs of the body is secured through (*a*) regular exercise, (*b*) bathing, (*c*) clothing, and (*d*) the ventilation and heating of the buildings in which we live.

(*a*) Regular physical exercise accompanied by sweating and followed by a bath which is terminated by a dash of cold or cool water is a procedure that does much to exercise the vasomotor system and put it in efficient condition; consequently, such habits as these make us less susceptible to "colds" and other respiratory affections.

(*b*) A cool or cold sponging of the neck and shoulders on rising in the morning or a cool or cold shower or tub bath at that time followed by a brisk rubbing of the skin with a coarse towel will improve the action of the heat-regulating mechanisms of the body. Some individuals can not stand cold bathing. If one is blue and cold after his bath and does not react he should not attempt such habits.

(*c*) Clothing should be worn for comfort. If the room temperature is between 64° and 68° F. the underclothing should be as light as that worn in summer. One will do better to depend on heavy clothing—overcoats, high overshoes, and gloves—when he leaves a warm room for the cold exterior in the winter, than to perspire in the house because of heavy clothing and a high room temperature and then meet the outer cold with damp underclothes and a poorly trained vasomotor system.

The underclothing and the outer clothing should be porous. Rubber clothing and tightly woven fabrics do not permit ventilation through their textures. They lead, therefore, to excessive surface heat and consequent perspiration without evaporation and drying.

XVII

CARE OF SPECIAL ORGANS—*Continued*

Care of the Kidneys.—The kidneys are the chief excretory organs of the body. Their labors are increased if the other organs of excretion are inactive. One protects his kidneys when he keeps his skin active and his bowels open. If one drinks too little water, his urine will be concentrated, acid, irritating, and reduced in amount. Six or eight glasses of water a day will dilute the urine and save the kidneys

in the normal individual. Alcoholic drinks, excessive meat diet, too much sugar, and rhubarb are influences that injure the kidneys.

Care of the Bowels.—The bowels should move effectively at least once each day. A glass or two of water before breakfast; a diet including cereals, milk, coarser bread, vegetables and fruits; regular habits of general exercise, and regular habits of defecation, will keep the bowels free and regular. It is unwise to depend on medicines. The habit is the thing.

XVIII

CARE OF SPECIAL ORGANS—*Continued*

The care of the reproductive organs is a matter of supreme importance from the point of view of heredity and healthy offspring.

Gonorrhea does more to make men impotent and women sterile than any other—perhaps more than all other causes combined. Gonorrhea is avoidable.

Syphilis is the most important infectious disease in its destructive influence on the germ cells of men and women, and syphilis is avoidable.

Alcohol is the most common cause of injury to the germ cells. Drinking is a habit.

There are other poisons of lesser importance that might be mentioned in this connection, such as lead poisoning and poisoning with the nitrate of mercury.

Any influence that injures the germ cells in man or woman is an influence that leads to sterility, early death of offspring, or to bad heredity.

One's problem of health, then, brings him an obligation not only to himself but also to the lives of his offspring, for whose health and happiness or for whose misery and pain he may be responsible. He must protect himself and his family, his children and his children's children by leading a reasonable, continent, sober life.

XIX

CARE OF SPECIAL ORGANS—*Continued*

Care of the Eyes.—The eyes are frequently infected at the time of birth. A great deal of blindness is due to neglect of the eyes at that time. It should be an unvarying rule that the eyes of all babies be treated with nitrate of silver or argyrol within a few minutes after birth. Either of these two salts of silver will destroy the organisms that are the common causes of ocular inflammation. Such treatment

should be administered only under the direction of the expert nurse or physician.

Eye infections may be spread through the use of the common towel, facecloth, handkerchief, or napkin. One should always use his own towel, his own handkerchief, his own washcloth, and never the towels, or cloths of others.

Mild irritations of the eyeball and eyelids are common at all ages. They sometimes become serious. Such irritations may be prevented or cured by washing the eyes two or three times daily with a 2 per cent. solution of boric acid in warm water. The application is best made with an eye-cup or a pipette.

Intense light causes eye strain. Infants and young children should not be permitted to expose their eyes to the direct rays of the sun or of artificial light of high candle-power. Habits of eye protection from such injury should be taught early in life.

One should not read with his eyes bared to direct rays of light. In reading, writing, or any other close visual application the light rays should come from the rear of the individual or they should be so diffused as to give adequate illumination without any points or areas of intense, brilliant light in the field of vision. Illumination of varying intensity soon tires the eyes. Long lines, close print, small type, faint impressions, thin letters, ragged, blurred or decorative type, indefinite contrast between print and page; indistinct contrast between color of ink and color of page; glazed or shiny paper; uneven surfaces (books that do not open flat); moving or vibrating surfaces (street-car reading), and excessive or inadequate illumination are factors in the production of ocular fatigue, eye strain, and defective vision.

Individuals with uncorrected defects of vision are naturally more susceptible to visual fatigue than are persons with normal eyes. Prolonged reading, writing, or other visual activity often leads to fatigue and eye strain even in normal eyes.

Defects of vision should be corrected with great care. Glasses should be prescribed and fitted by experts. It is important to get the right lenses. It is equally important to get the right frames and fit them to the eyes. A poorly fitted mounting or frame will destroy the usefulness of good lenses. The glasses should be so held as to enable the wearer to look directly through the centre of the lenses. His line of vision should be at right angles to the surface of the lens at its central area. Glasses that tilt to one side, frames that are askew, nose bridges that lower the lens so that the wearer sees through the tops of his glasses, are factors that destroy the value and usefulness of lenses.

XX

CARE OF SPECIAL ORGANS—*Continued*

The Care of the Ears.—It is unwise to introduce hard, pointed instruments into the external canal of the ear. The drum is a very delicate membrane and such procedure may cause it injury and lead to infection. But the more serious problems of ear hygiene are connected with the hygiene of the nose and throat. Ear disease and loss of hearing are in the great majority of cases caused by the extension of disease from the nose or throat to the middle ear by way of the Eustachian tube which leads from the nose and throat to the middle ear.

The habit of sleeping on the stomach is a measure for the prevention of a drainage of fluids from the nose and throat into the middle ear. Babies should be taught to sleep in this position for this reason if for no other.

It is unsafe to exert much air pressure in blowing the nose. If the nostrils are reasonably free they may be cleared one at a time by blowing through one while the other is held closed.

The hygiene of the nose and throat involves the repair of defects in those air passages and the treatment of their chronic affections. As has been stated before, all obstructions to nasal breathing should be removed, adenoids and tonsils should be taken out, and all reasonable measures taken to place the nose and throat in normal condition. Such treatment ought to be undertaken only by the experienced, conscientious and trustworthy specialist. The mere presence of a defect is not always a sufficient reason for its removal.

The individual will do well to gargle his throat regularly (or at least when he notes the presence of irritation) with a solution of a pinch of table salt in half a glass of warm water. Such a solution has about the salinity of the tears and serves as a soothing wash. It may be used also for douching the nasal passages, but fluids should not be forced into the nose. If the nasal passages are washed with a stream from a syringe or by snuffing there is danger of forcing the fluid into the passage to the ear.

XXI

CARE OF SPECIAL ORGANS—*Continued*

The Hygiene of the Teeth.—All decayed teeth and all dead roots and all root abscesses should be given expert dental attention. The teeth should be cleaned after each meal by brushing them gently with a soft tooth-brush. The brush should be applied with a ro-

tary motion. An unirritating tooth-powder is of service in the morning brushing. A mild salt solution—a pinch of salt in half a glass of warm water—may be used at night.

The spaces between the teeth are cleaned best by drawing threads of dental floss through them.

It is impossible, however, for one to keep his teeth free from tartar and green stain without the help of the dentist. Once or twice a year a competent dentist should clean the teeth so that all accumulations of tartar and green stain may be removed from the exposed surface of the teeth in front, on the sides, and behind.

Sore gums are less likely to appear when the teeth are kept clean, but when the gums do become sore their treatment is a problem demanding expert dental service.

The teeth should be examined at least once a year by a competent dentist. All dead roots and all teeth in which the nerves have been killed should be examined by the *X*-ray. These examinations will frequently discover abscesses connected with the buried roots. Proper treatment of such cases often leads to a cure of rheumatism, lumbago, backache, headache, and a large list of other ailments whose relation to "local abscesses" is only recently understood.

XXII

CARE OF SPECIAL ORGANS—*Continued*

The Care of the Heart and Blood Vessels.—The heart is a muscle and like all muscles it does its best work and maintains its best health while it is regularly exercised. But like all other muscles, it may be given too much exercise. Furthermore, the amount and kind of exercise that should be given the heart depends on its condition and on the condition of the more important organs to which it supplies blood. The proper exercise for a sick or crippled heart should be determined by an expert advisor. It should be remembered here that the rational prescription of general exercise must take into account not only the condition of the heart and blood vessels, but of the arteries, the lungs, kidneys, nervous system and other major organs. When there is no such trouble with the heart or other important organs ordinary recreational exercise should be taken. When there is a limitation from these sources, the exercise given may be regulated on the basis of the influence on heart rate, blood pressure and respiratory rhythm. It is easily possible to give beneficial exercise to a seriously crippled heart, and not increase its activity beyond the safe limit of its strength. This result is

accomplished through massage, passive exercise, and slow movements against little or no resistance.

If the heart receives too little exercise it grows weak and flabby. Its fibres degenerate. The result is an inefficient organ susceptible to injury and disease.

The heart should not be exercised while the individual is running a temperature. Extra labor at this time may lead to heart disease and heart injury. This is particularly true in the presence of rheumatic fever, diphtheria, scarlet fever and other infectious diseases.

Acute infections such as "colds" in the head and throat, tonsilitis, and other active infections, even if no fever is present, should be recognized as good reasons for not making any increased demands on the heart at the time.

The hygiene of the heart includes also the removal of all foci of chronic infection in any other organs of the body. We know that heart affections may be caused by infectious material transferred to the heart by the blood from *decayed teeth,* dead teeth and dead roots, diseased gums, diseased tonsils, sore throats, and other areas of chronic infection. The health of the heart then is dependent on the general health of the body, and the care of the heart means also the care of the other organs of the body.

The poisons produced during the activity of general infectious disease may lead to a degeneration of the heart muscle. The resulting weakness of the heart makes it necessary that the heart be given no relatively heavy work to do until the period of recovery is safely over.

Alcohol is a very common source of heart injury when taken regularly or in excess. The alcoholic heart is characterized by what is called "fatty degeneration."

In conclusion it may be said that heart exercise is essential to heart health; that prolonged heart rest means heart degeneration; that the prevention of heart infections is accomplished through heart rest during acute infections elsewhere in the body and through the successful treatment of the chronic infections of the other organs, and that heart weakness due to the poisons of febrile disease and such poisons as alcohol calls for greater care in heart exercise until recovery is complete.

The care of the arteries is intimately associated with the care of the heart. It may be stated, in addition, that the arterial walls harden with age, so that the health problems of older men and women are largely the problems of hardened arteries (arterio-sclerosis). This hardening of the arterial walls is hastened by various avoidable diseases, notably syphilis; by various dissipations, notably alcoholism; and by excessive labor.

XXIII

CARE OF SPECIAL ORGANS—*Continued*

The lungs and the upper air passages are chiefly organs of nourishment and of excretion. Through these organs the blood receives its supply of oxygen from the air which it carries to every living cell in the body. Through these same organs the blood discharges a large part of the carbon dioxide which it receives as waste (fatigue products) from every living tissue cell.

Lung power, respiratory efficiency, or respiratory endurance is a product of rational respiratory exercise. The lungs of inactive sedentary life are relatively of small capacity and limited efficiency. They fatigue easily and are frequently diseased. The outdoor school, the fresh air school, the open-window school, the porch bedroom, out-of-door life, regular respiratory exercise, muscular activity that induces respiratory activity, are various sources of respiratory exercise where value to lung health in particular and tissue health in general is now widely recognized.

The health and therefore the efficiency of the lungs are injured by any influence that restricts the free play of the chest wall or the diaphragm. A tight belt, waistband, vest, or tight suspenders, stooping posture, flat chest, spinal curvature, and funnel chest, are examples of such influences.

Lungs that are supplied constantly with dusty air are very likely to become diseased. Such lungs are usually tubercular. The dust may be ordinary dust. It may be factory dust, shoddy, metal filings, emery powder, crushed rock, cement. It may be mine dust, quarry dust, mill dust. The result is quite the same. Smoky, sooty air and air that contains gases and chemical fumes leads to respiratory damage.

XXIV

CARE OF SPECIAL ORGANS—*Continued*

The Bones Form the Framework of the Body.—This framework serves for the attachment and support of other organs. Some of the bones, notably those of the head and spinal column, protect important and delicate organs. Other bones are levers which under the dominion of the voluntary muscles enable us to move about or to move objects about us. The marrow of the bones manufactures most of the formed elements in the blood—that is, the blood corpuscles.

The most important early consideration in the hygiene of the bones

is their nourishment. Bones that are poorly fed are weak and unhealthy. Undernourished children are "rickety." Their bones may be underdeveloped, deformed and crippled. The undernourishment of the child may be due to the inability of the child to digest its food or to a lack of nourishment in the food it receives. A baby that can digest milk easily starves on soft-boiled eggs and roast beef.

Constant pressure may cause abnormal bony changes, particularly in early life when the bones are plastic. Tight shoes produce misshapen feet. Tight clothing makes small chests. The mail-carrier is liable to have a low shoulder and a crooked spine. The very heavy man will probably have flat feet.

Posture tends to produce fixed bony positions. Habitual stooping of the shoulders leads to round shoulders, and flat chest. Persistent efforts to stand in correct posture eventually fixes the good posture as a habitual position. Habits of posture, standing or sitting, active or passive, tend to impress themselves on the shape of the bony skeleton. The pressure of such habits records itself permanently on the bones. Good habits of posture should, therefore, be established in early life.

The common injuries to bones are breaks (fractures) due to mechanical causes. These injuries are usually the results of carelessness and are ordinarily avoidable. Failure to take intelligent care of broken bones not infrequently leads to incapacitating deformity after the break has healed.

XXV

CARE OF SPECIAL ORGANS—*Continued*

The joints of the skeleton make bony movements possible. A poor joint or a stiff joint limits or destroys movement in the bones and muscles directly concerned. Such a joint limits more or less completely the normal exercise of the tendons, ligaments, nerves, and blood vessels that supply the joints, bones, and muscles concerned. It is evident then that the health of joints involves the health of other important organs.

The most important health habit for the joints of the skeleton is exercise. The movable joints must be moved or they will lose their freedom and possibility of motion. A joint that remains in one position for a few days becomes stiff. If the position is maintained long the joint grows rigid and motion is impossible.

The joints, like the bones are affected by mechanical pressure from tight clothing or by habits of posture. The mobility of the joints between the ribs and spinal column may be limited by tight corsets or

vests; the mobility of the hip joints by tight skirts; of the joints of the feet by tight shoes, and the joints in general by the postural habits of sedentary inactivity.

The common infectious diseases of joints are acute rheumatism and gonorrheal rheumatism. The first may be avoided, to some degree at least, through good hygiene of the teeth and throat. A large number of cases of acute rheumatism or rheumatic fever begins with an attack of tonsilitis. Others come from infections of the teeth roots. Chronic local infections in these and other organs may be preliminary to infection of the joints and heart.

Gonorrheal rheumatism is a joint disease that is usually consequent on a gonorrhea of venereal origin. A life of physical uselessness may be the penalty for contracting an avoidable gonorrhea. Sometimes that penalty falls with relentless cruelty on the innocent victim of a faithless and guilty mate or parent.

Dislocations and strains are commonly due to mechanical injury.

XXVI

DOMESTIC HYGIENE

Domestic hygiene is the regulation of home and family sanitation and hygiene in the health interest of each individual within the family. The problems of domestic hygiene include:

(*a*) The location of the house with wise reference to sunshine, weather exposures, soil and drainage, good air, neighborhood nuisances such as smoke, gases, fumes, soot, dust (common or industrial), offensive odors, garbage, sewage, noise, and dangerous industries, and safety from fire and disease causes and disease carriers.

(*b*) Protection of the home from cold in the winter and heat in the summer, through an effective heating plant and sufficient opportunity for ventilation.

(*c*) Adequate natural illumination through window surface and outside exposure and sufficient artificial illumination through oil, gas, or electricity.

(*d*) Safe and sufficient water supply.

(*e*) Effective garbage removal and sewage disposal.

(*f*) An adequate supply of clean, nourishing food.

(*g*) An attractive preparation of food and a pleasing table service.

(*h*) Cheerful, happy home life.

(*i*) Wise instruction of children in the practice of health habits—habits of health information (safe literature, reliable lectures and demonstrations, regular health examinations and advice); habits of

bodily care (hygiene of the eyes, teeth, skin, etc.); habits of health protection (avoidance of the agents that injure health and of pathogen carriers); and habits of constructive hygiene for bodily growth, organic development, and functional perfection (products of wise habits of nourishment, adequate excretion, reasonable work, conditioning exercise, satisfying recreation, happy play, and sufficient rest).

(*j*) Sane preparation for parenthood.

(*k*) Reasonable plans for home defense against the causes and carriers of disease from within and from without.

XXVII

COMMUNITY HYGIENE

The successful acquisition and conservation of human health involves an education, a material resource, and a legislative and executive power which the single individual does not possess. Such information, resource and power may reside in the community. The individual must look to the community of which he is a part for better health opportunities, wiser health education and more effective health protection than he himself can provide.

The community can call on experts to plan its defenses against disease and its campaign for health. It can command the financial resource necessary for the scientific construction, adequate equipment, effective maintenance and expert administration which such plans may involve. It has the authority to establish and enforce laws necessary for the success of those plans for the public welfare.

Community hygiene is concerned with:

(1) *The Health Education of the Community.*—(*a*) The mother that teaches her child good habits of nourishment, excretion, exercise, rest, and self-protection is giving her child a more valuable and important health education than it can ever secure anywhere else or in any other way. (*b*) The school that succeeds in teaching health habits to boys and girls is furnishing the community with more efficient women and men and is providing healthier fathers and mothers for future and better homes. (*c*) The health educational schemes of various community organizations, societies, business firms, churches, colleges, libraries, and civic departments accomplish much in their influence on general health intelligence. (*d*) Our knowledge of the causes of disease, the carriers of disease, and our defenses against disease is the result of a very great amount of careful, painstaking, scientific investigation, and is largely an accumulation of re-

cent years. There is much that we do not know. We can not hope for perfect protection against disease until science has taught us how to secure that protection. A substantial encouragement of the scientific study of the causes, carriers and defenses against disease should be a part of the settled defensive policy of every community.

(2) *The repair and treatment of physical defects* through (*a*) the medical inspection of school children, (*b*) the maintenance of public clinics, medical and dental, and (*c*) the support of public hospitals for mental as well as for medical and surgical cases.

(3) *Protection from injury* through (*a*) the building code. (*b*) The sanitary code. (*c*) Fire laws and fire protection. (*d*) Traffic regulation—speed laws. (*e*) Regulation of dangerous occupations. (*f*) Regulation of nuisances—smoke, odors, fumes, gases. (*g*) Isolation, suppression, destruction or removal of disease causes and carriers (covered by sanitary code, State laws, etc.) (*h*) Effective school hygiene.

(4) *Community nourishment* through (*a*) infant feeding. (*b*) School lunches. (*c*) Community charities. (*d*) Community water supply.

(5) *Disposal of excretions* through (*a*) sewage systems. (*b*) Street cleaning. (*c*) Regulation of stables, yard privies, pigpens, poultry yards, etc.

(6) *Community recreation and exercise* through (*a*) public parks. (*b*) Playgrounds. (*c*) Drives. (*d*) Recreation centers; and (*e*) public baths.

(7) *Community rest* through (*a*) regulation of hours of labor; (*b*) suppression of unnecessary noise; (*c*) time limitation of sleep-disturbing activities.

The common agents concerned with community hygiene here in New York City are: (*a*) The schools; (*b*) the Board of Health; (*c*) the various commissions on water supply; (*d*) the Tenement House Department; (*e*) the Street Cleaning Department; (*f*) the Police Department; (*g*) the Fire Department; (*h*) the Department of Charities and Correction; (*i*) the city hospitals and clinics; (*j*) the Department of Sewers; (*k*) the Park Department; (*l*) the Port Quarantine Station; (*m*) Board of Ambulance Service; (*n*) Commission of Public Parks; (*o*) Bureau of Public Baths; (*p*) Recreation Commission; and a great number of societies, associations, and enterprises organized voluntarily within the community.

Every community enterprise that increases the public health, decreases community disease and delays death. Every such enterprise brings added resource to the community in terms of greater happi-

ness, larger efficiency, and increased productivity. When our citizens are more healthy, when they are sick less, when they get well faster, and when they live longer, they are worth more to themselves, their families and their community. Every community investment that leads to such results is an economy that more than pays for itself in terms of everything that is worth while—from a reduction in crime, insanity, illiteracy, and vagrancy to an increase in culture, morality and thrift, and from a lower tax-rate to a higher idealism.

XXVIII

INTER-COMMUNITY HYGIENE

Inter-community relations, as between towns, cities, States, or nations, involve and emphasize certain special problems in hygiene and sanitation associated with trade, commerce, transportation and other means of inter-community exchange, communication, or contact. It is obvious that the chief concern in this special field of hygiene is with inter-community carriers of disease.

(*a*) The aerial transmission of disease from one community to another. There is probably no aerial transmission of infectious disease of great community importance. Mosquitoes are known to have been carried seventy miles by the wind. We have, however, gases, odors, fumes, smoke carried through the air from one community to another. Insect and bird life is no respecter of "city limits" or State boundaries. Flies, mosquitoes, gnats—our present information concerning the carriers of disease has not implicated birds. Noises.

(*b*) Inter-community water-carriers. The drinking water of one community may be infected from the sewage of another. The fish in common waters may carry disease from one community to another, *e.g.*, fish tapeworm, oysters.

(*c*) Railroads as inter-community carriers of disease. Railroad accidents, sanitation of trains, dining-car garbage, sewage from toilets, expectorations in and from cars, cattle trains, manure, diseased animals.

(*d*) Safety and sanitation of street cars, ferry boats, passenger vessels, and freight vessels.

(*e*) Safety and sanitation and regulation of inter-community vehicular traffic.

(*f*) Sanitation of cargoes; prevention of the importation of diseased animals and diseased animal products; rats; fleas; perishable foods.

(*g*) Regulation of human carriers; port quarantine; border quarantine; inter-city quarantine.

(*h*) Inter-community education; societies, congresses, commissions.

(*i*) Inter-community laws; Federal laws in the United States; international laws.

XXIX

SUMMARY

Our community health defenses have decreased sickness and death from pathogenic organisms enormously during the last century. But we have evidence that our individual health defenses have not been well cared for and that as a consequence here in the United States the death-rate from diseases of decay has recently been growing steadily higher in the various age periods. In America our hearts, blood vessels, and kidneys wear out earlier and more rapidly than in England, France, and Norway. Our habits of individual hygiene are generally poor in this country. It seems that we begin to pay the penalty for our earlier neglect noticeably soon after we reach the age of forty. We find ourselves then in poor health or our responsible friends bury us years before the appropriate time.

No one can safely estimate the losses we sustain each year in productivity, working time and life itself because of our poor and inadequate health habits, and particularly because of the early neglect of those habits. Our efficient citizenship loses extravagantly and enormously from this source. Our armies are weakened by myriads of men thrown into the military discard because of poor health.

If when your time comes you belong to the discard in peace or in war it is likely to be your own fault. If your health habits are poor, if your health influence upon your community is not constructive, you will be a liability, and in most cases you will be so because of your own blind carelessness. Your family, your people and your country need the best health there is in you, and they have a right to expect you to give your best.

Your obligation and your responsibility as an individual, and your obligation and your responsibility as a part of the community in which you live, will always be the same. Each requires, and that justly, that you make every reasonable effort to prepare yourself physically, mentally and morally for the exigencies of life and to influence your community to defend the health of its citizens with all its resource of brains and money.